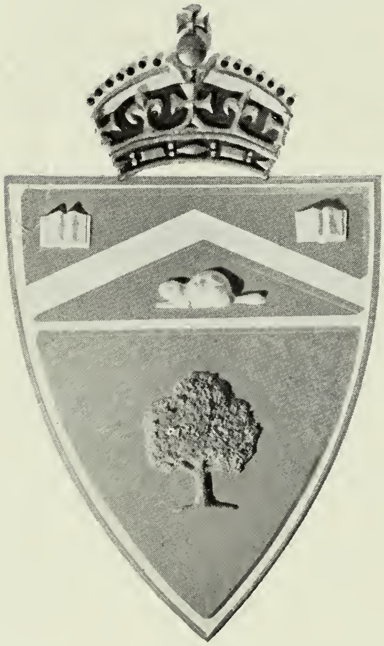
TRANSACTIONS

AND

YEAR BOOK

ENGINEERING SOCIETY OF THE UNIVERSITY OF TORONTO, 1937



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Faculty of Applied Science and Engineering

UNIVERSITY OF TORONTO

1936 1937

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TRANSACTIONS AND YEAR BOOK

of the

University of Toronto Engineering Society

No. 50. APRIL, 1937

FOLLOWING as we do, the year of a semi-centennial celebration, has its advantages and its difficulties. It seems that we have settled down to a routine that is one continuous celebration and an attempt to surpass all previous records, be they semi-centennial or otherwise. With those of the graduating class there will linger long the memories of such notable incidents as Napier Moore talking "Toike", at the School Dinner, Jack Denny at the School At-Home, and probably the greatest election campaign during their sojourn at the Little Red Schoolhouse. Retrospectively they represent enjoyable occasions, but also we see in them a reflection of the organization and greatness of our Engineering Society.

As its members, we must remember that we represent the Society, the Faculty and the University wherever we are, or whatever the circumstances. The election assault on University College may have been fun for those who participated, but how pointless it seemed to the hundreds who only heard about it. True, we are a lusty, clannish group, proud of our existence and anxious to let it be noised about, but we are still too practical-minded to neglect public opinion. The reputation and good name of the Engineering Society will stretch or shrink to the size of the men who make it. There is no better time than the present to begin influencing and educating public opinion with the greatness of the Engineering profession. We must lead them to recognize the fact that as engineers we are not the reckless hair-brained lot that we sometimes lead them to believe, but a capable, dependable group of professional men who merit and deserve their confidence.

We have had the opportunity this year of hearing at the general meetings of the Society, due to the energy and ability of the executive committee some of the most valuable and instructive addresses that have ever been delivered to the Society. Seldom if ever have we had the privilege of listening to so distinguished a guest as Sir Hubert Wilkins. The subjects have been varied and the appreciation of the members has been evident in their attendance. We realize that the broader the foundation, the higher may one rear the monument of success.

It seems that in growing and meeting changed conditions, we have gotten away from the original practice of meeting as a group of students to discuss topics of general engineering interest. The Clubs can do this so much better. However, the inaugural address of the President of the Society and the final annual general meeting are institutions that might well be revived. Surely there are many things in the mind of the President, who has probably given more thought to Society affairs than most of the members, that might well be aired at a general meeting. More and more are the executive committee working behind the scenes, so to speak. We do not demand showmen, but thinking men, and we look to these meetings for the promotion of thought on Society affairs and engineering affairs, rather than for entertainment.

As the Board of Editors for the year 1936-37 it has been our privilege to record this page of School History. The available space has been all too small to do it justice. In reproducing the most interesting and instructive of the addresses delivered to the Society, along with several theses and articles of interest we have attempted to cater to the interests of every department in some small way. Discussions involving the deduction of mathematical considerations have been eliminated. In our columns we have endeavoured to include subjects of timely import, which appeal to all in some part, and which represent best engineering practice.

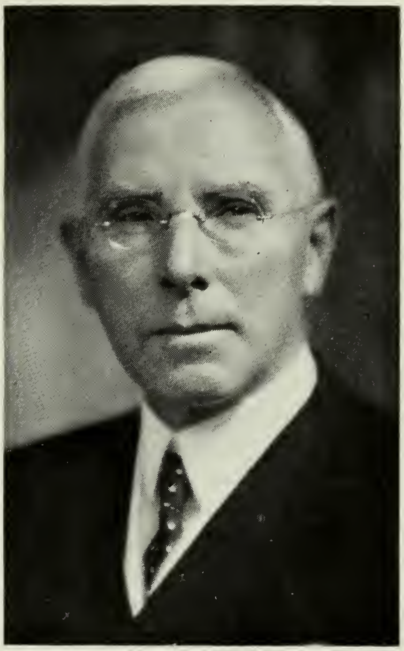
In the Year Book, we have undertaken to present School as School is. Praise should be given where praise is due, but there should be no hesitation to criticize when criticism will do most good.

It has been our policy to maintain and improve where possible, the quality of the book and not to seek innovations or radical changes.

With due apologies, having given of our best, and a sincere request for your thought and offerings of constructive criticism on the book, we give you TRANSACTIONS.

D. E. G. S.

The Dean's Message for 1937



TO THE MEMBERS OF THE ENGINEERING SOCIETY:

Gentlemen:

The year has gone steadily and successfully on in the Engineering Society and in student activities in the Faculty, in a manner which has reflected very great credit upon the Officers of the Society and upon its student members. The good solid things of this world are not measured by flashy yardsticks, but by careful, steady achievement in which appraisal is not by the short but by the long view. This is the manner in which this powerful society has been built up and by which it has steadily been maintained for over half a century.

I wish to congratulate the President and the Officers upon the manner in which they have carried on the extensive, diverse, and sometimes difficult, operations of the Society. May I include here also, a word of congratulation too, to the President and Officers of the Athletic Association, its close ally. All have worked hard, diligently and continuously, sometimes at considerable personal

sacrifice. I am sure that these services are appreciated by the Student body and equally so by the Faculty Staff, which looks upon the Engineering Society as a most valuable adjunct and aid in the conduct of Faculty affairs.

I desire also, to congratulate the undergraduates, and especially the members of the year now about to graduate, upon being here at the present time. Those who are about to leave and those who shortly will follow, will go out into the world at a time when they will be ready to take full advantage of the progress and the renewal of engineering and architectural activity which is now developing. I cannot help feeling that by the time you members of the junior years get out there will be a busy Canada awaiting your arrival in all fields of engineering. The Class of '40 is likely to hit the rising wave full on.

I suggest to you that you keep in mind other things that go with university life and university graduation, beside the scientific and practical ones that go to make up the education and preparation of an engineer. There are higher things which are due ourselves and our fellow countrymen as graduates of a university, and especially of such a unique place as has the environment of "School".

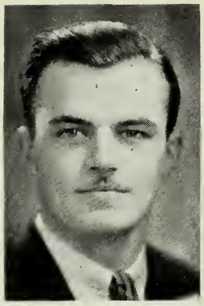
People often try to apply a yardstick of some kind to human greatness, but without much success. Everyman, even if he be a genius, is necessarily measured by his aims in life and in the end, by the degree to which he has actually achieved them. I think it can be well an aim of a university graduate to make for himself the formula that his life belongs to his race and his fellow countrymen, and that only from the store of talents with which he has been blessed, can he in turn, give for the sake of Society.

I wish you all the best of success and good fortune—which you all fully merit—and wherever you of the Graduating Class may be, remember that there are three other years following you who have lived along with you in these happy days, who will still look up to you as their leaders; there are many things you can do for them. You will, as "Schoolmen" do!

Yours faithfully,

C. H. Mitchell,
Dean.

President's Message



By the time you read this message the activities of the Engineering Society for the year 1936-37 will be history. The general concensus of opinion is that we, as an undergraduate society, have maintained our position at the head of all similar organizations at this and other Universities.

Since its founding fifty-one years ago, the Engineering Society has steadily expanded in its activities until to-day it is the most active and most financially sound single faculty organization on the campus. We are pleased to say that its founder, Dr. T. K. Thomson, has lived to see his brain-child prove such a success. We know he is still proud of it.

The organization and carrying out of the various branches of endeavour participated in by Schoolmen, is an enormous task, but it is greatly simplified by the whole-hearted co-operation of the members with their Executive Committee.

Although all of our activities are reviewed in detail in other parts of this book, a few of them are worthy of mention here.

The Supply Department as shown in the Financial Statement on the last page has enjoyed better success than in the past few years. This is due partly to improvements in economic conditions, but the greatest credit goes to the efforts of George Beard and his assistants Miss Lowry and Miss Packman. The Supply Department takes much of the time of the Second Vice-President, and it is necessary for him to be back at School long before registration in the fall to get things into shape for the advent of members demanding supplies.

Our social activities, School Dinner, School Nite and School At-Home were most capably directed by Vern Leworthy. They were all and more than could be desired. Vern and his committees deserve much praise for the hard work and time they spent in planning these functions.

Mr. H. Napier Moore, our guest of honour at School Dinner, presented one of the most excellent and interesting addresses ever heard at this brilliant event.

School Nite was a record-breaker for attendance this year. This had the effect of greatly reducing the Society's subsidy necessary

to make School Nite the best informal party at the University. Director Willy Arison and his cast deserve hearty congratulations for the fine show in the theatre.

School At-Home, which is recognized each year as the outstanding social event on the campus, was even more brilliant this year due to the importation of Jack Denny's orchestra from New York. It was rather disappointing to the committee that more Schoolmen did not attend.

The elections which were carried off in a livelier manner this year than for the past few years, were handled by Clay Hall. The U.C. Front Door Incident on this occasion will long be remembered.

In interfaculty athletics, School has done remarkably well. Ross Clark, the president of the Athletic Association and his executive deserve much praise for their successful efforts in planning their programme.

A new departure of printing the Toike Oike on coloured papers with coloured inks was successfully introduced this year and has greatly improved this publication. The editor, Art Rogers, did a tough job well.

The production of TRANSACTIONS, which necessitates more work and at a more inconvenient time of the year than most of the Engineering Society endeavours, was very successfully handled by Don Schmitt. This year's TRANSACTIONS maintain its reputation of being a fine publication.

Many others are worthy of mention in this hasty review of the year's activities. Such men as Bev. Bronskill, Tiny McBane, Alec. Ramsay, Jim Kerr, Alec. DeMaio and Al Penney should not be forgotten. The Club chairmen also deserve compliments for the fulfilment of their duties.

It has been a pleasure to serve you as President during the past year. I have done my best to maintain the traditions of this office and I hope that I have succeeded to some extent. To the members of the Executive Committee I wish to express my appreciation for their valuable assistance in conducting the activities of our Society.

Next year there will be a new and most capable President, George Beard. To him and his executive I extend my best wishes. George will be the fiftieth student President of the Society, and I am sure he is the proper man to receive such an honour.

TRANSACTIONS

Production Control

Thesis submitted for the degree of B.A.Sc. in Mechanical Engineering

BY J. A. BURGESS

"The engineer is, by nature, an economist." This is true of the technical as well as the financial aspect of engineering. On all sides, the engineer is faced with opposing tendencies and he must compromise between them. In this competitive age, the profit motive must influence his choice. Since profits have become the yardstick of engineering success, the study of production control has been developed to increase profits by eliminating many losses of time, labour, and material. The subject of production control has not been treated fully in this paper but certain aspects of it have been discussed, stressing particularly, the determination of lot sizes and a typical procedure for scheduling.

The conception of organized production control is a distinctly modern idea. Skill in the crafts is as old as the Pharaohs; division of labour took place at an early date and, in certain arts, the ancients are still unapproached. But controlled, progressive manufacture is largely a development of the present century. Whereas the early factory brought together independent craftsmen in sufficient numbers to produce the desired output, the modern plant is an integral operating unit with the production control department as the guiding force behind all of its activities.

Flow Industries

Some sort of a classification is necessary in analysing any particular situation with a view to developing a working system. The two basic manufacturing types are the flow industries and the special order industries.

Let us start with the simple case of the flow industry, where only one product is being made. The only variable in this case is volume. Output must be increased during busy seasons or cut down when work is slack. Once a balanced production unit has been established, there is little change from day to day and such changes in output as are necessary to meet fluctuations in sales are made by a simple increase or reduction of hours or of force.

However, it is only rarely that an industry makes only one product with no variations. A more common type of industry is that

in which one main line of products is made, all manufactured in approximately the same way, but with sufficient differences in pattern or model to require that orders be put through in separate lots.

This case will differ from the first in that there must be special design work for every order. So far as the process layout and scheduling are concerned, there will be little change. But since the needs of any customer can be met only by the completion of his particular order, the jobs must come through in the proper sequence.

Special Order Industries

At the opposite end of the scale from the flow industry are those industries in which orders are made up to a customer's specifications. In the flow type of industry it is possible to arrange machines entirely from the standpoint of smooth progressive movement of materials. In the special order business, an attempt is made to get the best average movement of materials, but the tendency is to group the machines on the basis of similarity of process rather than on the basis of operations on the product.

In the special order business, a new design and routing will be necessary in practically every case. The scheduling differs radically from that of the flow industry. While in the flow and modified flow industry, with balanced machine capacity, control of the first operation sufficed to control all, in the special order industry an independent schedule must be made for each machine.

The special order industry also has its modified form. If certain patterns are called for frequently, it is more economical to make up these patterns in larger lots and to fill orders from stock. Designs

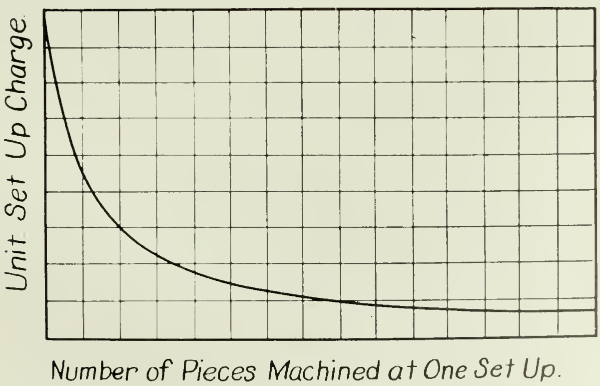


Fig. 1

and routing are standard, although some changes will have to be made to meet variations in the machine schedule.

Determination of Lot Sizes

In industries manufacturing to stock, the material, or its component parts, is made up from time to time in lots of a sufficient quantity to balance the cost of setting up a machine for the run and the risk and cost of carrying the part in stock. The way in which the unit set up charge varies with the size of the lot is shown graphically in figure 1.

From the above curve it is seen that the set up cost per unit is high for small lots but decreases rapidly as the size of the lot increases. On the other hand, interest, depreciation and storage costs increase as the lot size increases. A point of balance and of minimum unit cost may be found either graphically or by formula.

The ultimate unit cost of an article contains all the charges which accrue to an article up to the time it is finally removed from inventory. This cost will include:

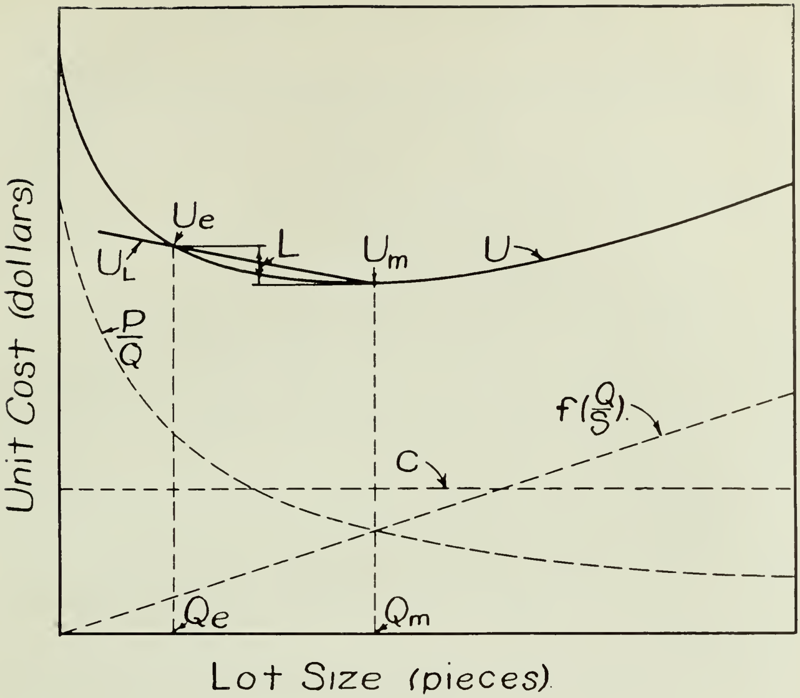
1. The production cost which is made up of the unit cost of material, direct labour and its overhead, in dollars per piece, which will be denoted by c.

2. The unit preparation charge which is found by dividing the total preparation cost, in dollars, by the lot size, in pieces. Where P is the total preparation cost and Q is the lot size, the unit preparation charge will be $\frac{P}{Q}$ dollars per piece.

3. The unit investment and storage charge. Where f is the unit investment and storage charge, in dollars per piece per year, and S is the yearly rate of consumption in pieces per year, the unit investment and storage charge will be $f\left(\frac{Q}{S}\right)$.

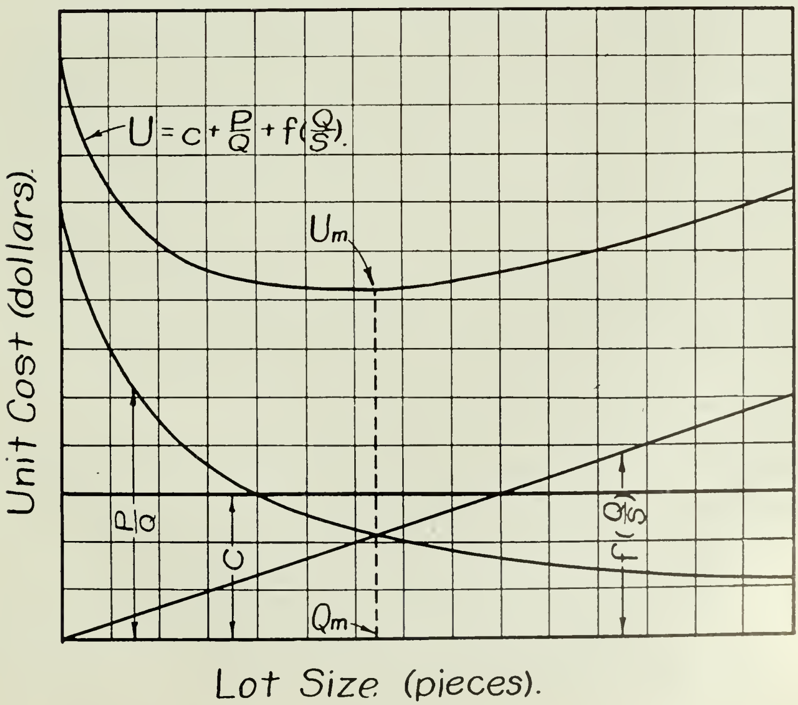
Thus the ultimate unit cost $U=c+\frac{P}{Q}+f\left(\frac{Q}{S}\right)$.

The curve of ultimate unit cost is shown in figure 2, where it is seen that the minimum point occurs at the point where the unit preparation charge $\frac{P}{Q}$ is equal to the unit investment and storage charge $f\left(\frac{Q}{S}\right)$.



Unit Cost (dollars)
Ue
L
Um
U
UL
P/Q
f(Q/S)
C
Qe
Qm
Lot Size (pieces)

Fig. 2



Unit Cost (dollars).
U = c + P/Q + f(Q/S).
Um
P/Q
C
f(Q/S)
Qm
Lot Size (pieces).

Fig. 3

Then for the minimum value of the ultimate unit cost:

$$\frac{P}{Q} = f\left(\frac{Q}{S}\right)$$

Solving for Q_m the minimum cost quantity:

$$Q_m = \sqrt{\frac{P\,S}{f}}$$

As a result of an investigation into the practical application of this general formula, it has been found that another factor should be included because, in deriving an expression for the minimum cost quantity, only the viewpoints of sales and production were considered. The financial interest must also be introduced to properly conserve capital.

To demonstrate how the factors of sales, production and finance are interlocked, we shall consider a concrete example. Let it be assumed that $220,000 worth of business can be obtained in a year from an investment of $100,000 from which a return of 10 per cent is obtained.

The gross return, then, will be $20,000 because the initial capital must be turned over twice a year. Now let the lot size be reduced to a point where the same amount of yearly business can be done on an investment of only $25,000. Again assuming a return of 10 per cent, the profit on each turn-over of capital will be only $2,500. However, the smaller lot size will permit a turn-over of eight times a year and this will bring the gross return up to the original $20,000. But the smaller quantity will be the better lot size because, with an average expenditure of only $25,000, each dollar will return 80 cents profit, whereas with an average expenditure of $100,000 the return on each dollar is only 20 cents.

If any benefit is to be derived from the conservation of capital by using the smaller lot size, which will permit the average expenditure to be reduced from $100,000 to $25,000, the natural increase in cost must be offset in some manner so that the same gross return will be earned as in the first case.

Assuming the capital invested in the fixed assets represented by the manufacturing facilities employed in the process to be constant, the increase in the capital investment will vary directly wtih the lot size. For this reason smaller lot sizes than those already indicated can be used since the increase in cost will be offset by an equivalent reduction in the unit capital charge. The extent to which the unit cost can be increased, without effecting the gross return, is shown in figure 3 by the straight line U_L.

The line U_L is definitely located since it passes through the point of minimum cost and its slope is equal to:

$$\frac{i\,(C-C')}{S}$$

where i is the rate of interest
C is the unit capital investment
C' is that part of the unit capital investment due to fixed assets
S is the yearly consumption.

The line U_L intersects the curve U in a second point Q_e. This corresponds to a smaller lot size and since the increase in unit cost $L=(U_e-U_m)$ can be exactly offset by the reduction in the unit capital charge, the gross return for the year is still maintained at an amount equal to that for the minimum cost quantity. This lot size is designated as the economic production quantity and the range between the economic quantity Q_e and the minimum cost quantity Q_m is called the economic range. Any production quantity within this range can be employed in the scheduling of production without any computations to check the reliability of the quantity so selected.

The Purpose of Systematic Production Scheduling

The successful application of the results obtained by the determination of economic quantities depends on the efficiency and uniformity of manufacture. The establishment of a reasonable production schedule, which is systematically carried out, is the only way to avoid the delays which are inherent in the older systems, where stock-chasers, responsible only for their own lot of orders, endeavoured to get their particular orders through, regardless of the orders already in the shop. The supply of raw materials must also be considered. By advance scheduling, the purchasing department is enabled to buy to better advantage and provide for a better delivery of material.

When unexpected breakdowns temporarily interrupt production, the schedule will enable continuity to be restored in the shortest possible time after the repairs have been completed. In normal times, the schedules will contain small allowances for such delays. In any case, the need for stock-chasers will disappear because, even if the production is behind schedule, no number of stock-chasers can get nine hours of work out of a machine in eight hours. The whole control of the sequence of orders is in the hands of a single department, which is in a position to keep itself continuously informed of

changes in the customer's needs, plans of the sales department and similar emergencies, whose direct impact is so demoralizing to a production schedule.

To sum up, the production scheduling accomplishes the following results:

1. It enables the sales department to make promises which are reasonably certain of being fulfilled.
2. It reduces the capital needed to handle a given amount of sales.
3. It tends to prevent production delays by foreseeing future requirements.
4. It enables the plant to get out the maximum possible production.
5. It tends to keep all machines busy, thus doing away with the loss which an idle machine entails.
6. It reduces the unit cost of output.

Time Study and Process Analysis

Production schedules are based on time studies, process analyses, and other steps of standardization upon which dependable estimates of production requirements are based. Many firms continue to get along with looser and less efficient systems because they have a natural prejudice against the so-called "non-producers" who make the time studies. The establishment of standard times is really a capital investment, as are the production of standard drawings and specifications, and the determination of economic production quantities. It has been repeatedly shown that the work of time study and process analysis does pay its way and shows a considerable profit besides. Time study is necessarily the first step in a program of production scheduling because the extent to which the schedule can be met will depend on the accuracy with which it is made.

The Master Schedule

The first step in production scheduling is the making of a master schedule which indicates the relative importance of manufacturing orders. In scheduling production, manufacturing orders originating directly from customers' orders or as part of the manufacturing budget, must be so arranged that the plant may be operated at its maximum manufacturing effectiveness. Where possible, each productive unit should be provided with work to allow it to operate continuously. It is not desirable, from the standpoint of either management or men, to work on an irregular schedule. Orderly,

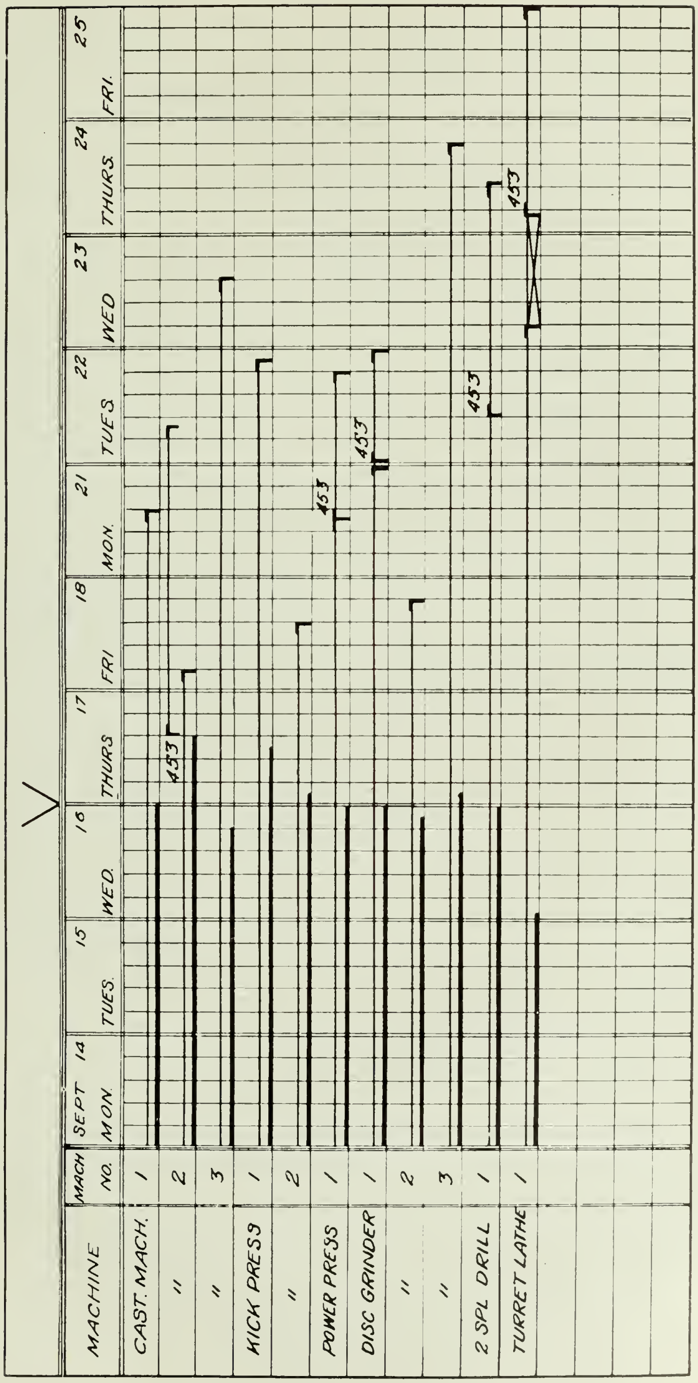

MACHINE
MACH NO.
CAST. MACH. 1
" 2
" 3
KICK PRESS 1
" 2
POWER PRESS 1
DISC GRINDER 1
" 2
" 3
2 SPL DRILL 1
TURRET LATHE 1
MON. SEPT 14
TUES. 15
WED. 16
THURS. 17
FRI 18
MON. 21
TUES 22
WED 23
THURS. 24
FRI. 25
453
453
453
453
453

Fig. 4

advance scheduling tends to equalize production in spite of fluctuations in the market.

The manufacturing orders are subject to subdivision into economic manufacturing lots. A single manufacturing order may cover only a portion of the manufacturing budget for a certain article, or it may combine two, or more, customers' orders for the same article. Thus, small customer's orders, or large stock orders, may be increased, or subdivided into profitable manufacturing quantities.

While there is no hypothetical grouping of orders that will be fully satisfactory in all plants, there are, nevertheless, certain general considerations which must govern the scheduling in any plant. When a customer stipulates a delivery date prior to the time at which the product would naturally be completed in the ordinary course of production, the order must be given precedence over the regular run of business. Stock orders are usually utilized to fill in the gaps between customers' orders and cover the staple products for which there is a constant demand.

The actual form of the master schedule is incidental to the purpose of this paper. The important point is that a master schedule is drawn up which gives the order in which work is done, the quantities required and the delivery dates for rush orders.

The Gantt Layout Chart

Because of its presentation of facts in their relation to time, the Gantt chart has been extensively applied to industrial scheduling and progress records. The Gantt layout chart is used in working out a plan to get orders in hand done when they are wanted and to make the best possible use of available men and machines. No method of doing this can be satisfactory unless it emphasizes, above everything else, when jobs are to be begun, by whom, and how long they will take.

In the Gantt chart, a division of space represents both an amount of time and an amount of work to be done in that time. Lines drawn horizontally through that space show the relation of the amount of work actually done in that time to the amount scheduled.

A typical Gantt layout chart is shown in figure 4. All production centres are listed on the left side of this sheet. The rest of the sheet is divided into columns representing time. In this case, the chart covers two weeks of five ten-hour working days each and each working day is divided into five two-hour periods. The divisions of time depend on the average length of the jobs and the accuracy with which the production times can be predicted.

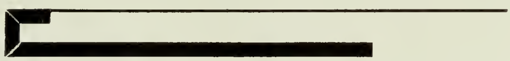
When an order is to be scheduled, the first operation is laid out on the layout chart opposite the machine to be used. An angle opening to the right:

indicates when the job is to be started. An angle opening to the left:

indicates when the job is scheduled to be completed. A light line connecting the angles indicates the total time scheduled for the operation:

The second operation is laid out opposite the machine to be used. Sufficient time is allowed after the beginning of the first operation so that a steady supply of material from the first operation will be available at the second machine. This procedure is repeated until all the operations have been scheduled.

In assigning work to machines, it is necessary to know what progress has been made on work already assigned. Accordingly, as daily reports are received showing the amount of work done, a heavy line is drawn under the light line:



If the work is exactly on schedule, the end of the heavy line will be exactly under the proper date and hour. If the work is behind or ahead of schedule, the end of the heavy line will be behind or ahead of the date. In assigning a new order to a machine when the work is ahead of schedule, the new order is placed over the old one and the time of beginning is placed in advance of the date of completion of the old order. If the work is behind schedule, there is no advantage in planning to begin the new order until the old one is completed. Therefore, sufficient time must be set aside to make up for past delays before the new work can be begun. Time allotted for the completion of work behind schedule is shown by connecting the angles by crossed lines. The time at which the schedule is made is indicated by a V at the top of the chart. The number of the order is placed at the right of the time scheduled for the operation.

For a definite example of the procedure in laying out a schedule on the Gantt chart, let us consider the scheduling of the production

for 5,000 circulating-pump housings, in a zinc die casting plant.

The process analysis supplies us with the following information:

Opn. No.	Operation	Machine	Set up time hours	Time/100 hours
1	Cast	DC	2.25	0.50
2	Trim	PP	1.50	0.25
3	Face	DG		0.20
4	Drill and tap 4 holes	2SD	0.50	0.40
5	Thread	TL	1.00	0.35

The total time for each operation is calculated from the above figures.

$$\text{Time for operation } 1 = \frac{5000}{100} \times 0.50 + 2.25 = 27.25 \text{ hours}$$

2	13.00	"
3	10.00	"
4	20.50	"
5	18.50	"

Now, turning to the Gantt layout chart which is shown in figure 4, it is seen that casting machine No. 2 is scheduled to finish an order on Friday, Sept. 18th, at 9.00 a.m., and that, at the time the schedule is made out on Wednesday night, the machine is six hours ahead of schedule. For this reason, the order for the circulating-pumps, No. 453, is scheduled to begin six hours ahead of the scheduled completion of the present order which will be Thursday, Sept. 17th, at 2.00 p.m. Since the first operation will take 27.25 hours, the operation is scheduled to be completed at 10.15 a.m. on Tuesday, Sept. 22nd.

The production of the power press is exactly up to date but the machine is not available for order No. 453 until Monday, Sept. 21st, at 1.00 p.m. At this time there will be 2,325 castings from the first operation ready to be trimmed and so it will be safe to start the second operation at that time.

Operations 3 and 4 present no difficulty in scheduling but, when it comes to operation 5, it is seen that the turret lathe is scheduled up to 9.00 a.m. on Wednesday, Sept. 23rd, and it is already 9.50 hours behind schedule. In order that the present order may be completed before starting order No. 453, an additional 9.50 hours is allowed. This will permit the final operation on order No. 453 to be completed on Friday, Sept. 25th, at 6.00 p.m.

This graphic layout makes it possible to intelligently distribute orders over the available machines. When a machine breaks down,

or falls behind schedule, it is necessary to transfer work from it to other machines and the layout chart shows how this may be done without disturbing the proper sequence of orders. The chart helps to get work done because it makes clear who is to do any piece of work, when it is to be done, and how long it will take to do it. Since it is possible through this chart to assign definite tasks, confidence will be created because the more definite the task, the easier it is to get it done.

Conclusion

Enough has been said to indicate that there are two distinct phases to production control. In the detailed phase, production control is the matter of the choice of systems, of day-to-day adjustments and co-ordination of the machine program, production quantities and other elements, to use the plant's capacity to the best advantage and to give the customer the quick delivery for which he is always anxious.

In its wider phases, production control involves the whole policy and plan of operation of the business. It demands the direction of a man broad enough to see the problem from the standpoint of the sales department, the financial interests, and labour, as well as from that of the schedule maker.

History of the Development of the All-Sliming Process of Cyanidation

Thesis submitted for the degree of B.A.Sc. in Metallurgical Engineering

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Preface

It is proposed to trace the development of the all-sliming process of cyaniding, particularly of gold ores, from the time of its inception in South Africa in 1906 to the present.

Because the differences in the chemistry of this process as compared with that of the percolation method of treatment are only differences of degree, its evolution is mainly concerned with the development of machinery and apparatus for handling finely crushed material in liquid. An effort will be made to trace the

influence of the more important kinds of apparatus, as developed, on methods in general use for ore treatment. To this end, the subject will be treated under five different and perhaps arbitrary divisions, which will serve to systematize consideration.

These divisions are as follows:

A. Crushing.
B. Classification.
C. Thickening.
D. Agitation.
E. Solution Recovery.

General History of the Cyanide Process

The principles of a method for the recovery of gold from its ores by leaching with cyanide solution were discovered and patented by McArthur and the Forrests in 1899. The fact that gold would dissolve in solutions of potassium cyanide had been known since at least 1806 and in the interim much work had been done and many patents taken out for its extraction by this method, none of which enjoyed any degree of commercial success.

Accordingly, credit is due to McArthur and his associates, not as purely scientific inventors, but rather for applying some known principle in a commercially successful manner.

The original patents called for:

(*a*) The use of *dilute* solutions of potassium cyanide.
(*b*) Zinc precipitation, gold being precipitated on zinc shavings in a compact, easily recovered form.

The patents suggested that the crushed ore be agitated in barrels with revolving arms with the solution and that the solution should be recovered with some form of filtering device.

With these patents as a working basis the cyanide process was adopted within a few years almost wherever gold was mined and treatment methods very quickly became diversified to handle the different ores and conditions in different places. All-slime treatment did not receive general recognition until 1906, but it will be interesting to follow trends in apparatus used for slime handling up to that time so that the basis for its development from then till the present will be fully appreciated.

Definition of Slime: When rock is crushed it is broken into fragments of varying sizes down to an impalpable powder. Both the physical and chemical properties of a substance with such a large surface area are complex and may differ from similar material in a coarser state of subdivision. However, it seems that in so far

as results are concerned, an exact definition of slime is unnecessary beyond a determination of its susceptibility to ready treatment by solution.

Park gives just such a definition: "Slime is that portion of a crushed ore, which because of its smallness of particle size and its shape factor—talcose condition for example—will settle with extreme slowness in water and requires extra pressure in filtration."

Slime-handling Up to 1906

A. Crushing

Rock-breaking methods have very little effect on the slime in a final product and need not be considered.

The following machines were in general use in gold metallurgy in 1890:

1. The stamp mill.
2. The Chilean mill.
3. The Huntingdon mill.

1. *Stamp Milling:* Was first introduced to gold milling in California and by 1890 of course was almost standard practice for amalgamation everywhere.

A stamp mill consists of a row of vertical stamps, cylindrical, and usually five in number, which are lifted up and allowed to fall alternately on an iron anvil. The individual stamps are mounted on vertical steel shafts with a collar near the top and this collar is engaged by a cam which lifts the shaft up. The fineness of the crushed product is regulated by a screen on the discharge.

The advantages of a stamp mill are as follows:

1. Simplicity of construction and operation.
2. Cheapness of construction.
3. Ease of control.
4. A large range of reduction.

Stamps have the disadvantage of being very noisy in operation and are quite inefficient as regards power consumption. Since they provide unexcelled advantages for plate amalgamation, their use at this time was so general that other types of grinding apparatus were the exception to the rule.

2. *Chilean Mills:* Consist of three or four vertical heavy steel discs revolving about a central shaft, on a steel plate, the ore being crushed between the revolving discs and the plate. The peculiar virtue of such a mill apparently lay in its supposed ability to crush fine with a minimum production of slime.

3. *The Huntingdon Mill:* Is similar in properties and effect;

the steel rollers are four in number and horizontal and are pressed outwards by centrifugal force against a heavy steel ring as they revolve. Discharge is splashed through a screen above the rollers.

Both these mills use wet grinding and the Huntingdon Mill was used for amalgamation right in the mill itself. They are quieter and more efficient than stamps and fairly cheap to install; however difficulties of plate amalgamation apparently prevented their general use in place of stamps.

The first cyanidation was practised on tailings in South Africa, which were the product of stamp batteries, and passed through about a 40 mesh screen. As these tailings became exhausted the ore was cyanided directly from the stamp mills. It was soon found that slime in the product tended to complicate further handling, consequently the early efforts were directed to grinding with a minimum production of slime. To this end, the use of dry crushing in rolls was often employed, especially in New Zealand. Rolls give possibly the most even product of any crushing device provided that the reduction in one step is not too great and the rolls are not fed too rapidly. Chilean and Huntingdon Mills were more used during this period for the same reason.

By 1896, however, the difficulties incident to slime handling had been overcome sufficiently to render its treatment commercial, and less attention was then necessary to prevent its formation. The fact that finer crushing gives in general higher recovery was known, so that finer screens were used on stamp-mills with a view to obtaining a finer sand product, the production of more slime being incidental.

Tube-mills had not up to this time been used in the mining industry, but had been in common use for fine grinding, especially in the cement business. A single case of the use of such a mill for grinding gold ores previous to 1899 is on record. J. R. Browne in a letter to the secretary of the United States Treasury dated March 5, 1868, describes the mill of the Bear Valley Mine in Mariposa County, California, in the following manner:

"The Bear Valley Mill has twelve stamps and a Lundgren pulverizer. This pulverizer consists of a boiler shell with a door on the side, which is filled with 800 pounds of quartz ore and 2400 pounds of musket balls. It rotates horizontally about the axis of the cylinder and the quartz is ground from about the size of wheat to an impalpable powder."

This machine corresponds exactly to a modern tube mill, although it apparently worked as a batch-process, and it would

seem that Lundgren was thirty years ahead of the rest of the industry in his grinding method.

A tube mill consists of a revolving hollow cylinder filled with balls of stone or metal. Ore is fed in at one end and discharges at the other and is ground between the balls as they are jostled about in the revolving tube. About 1898 in Western Australia, it was realized that fine crushing was the only satisfactory way of obtaining good extraction on the refractory ores. In June of 1899, Diehl introduced the use of tube mills to Kalgoorlie as a part of his Diehl process. Western Australia was a pioneer in the development of tube milling. Tube milling was somewhat later introduced to Colorado where the ores are similar; and in the two camps wet crushing of ore was used.

The original all-slime treatment of ores can be credited to Western Australia. In addition to the Diehl bromocyanide process of fine grinding, the roasting of finely crushed ore was also employed in Western Australia.

The Diehl process involved concentration and roasting, but the whole ore was reduced to slime in tube mills. The roasting process involved dry crushing in Krupp ball mills, roasting, and final sliming in pan mills.

In 1903, the Denny brothers published a paper which suggested that similar methods be applied to Rand ores. Their paper contained the following points relative to crushing.

1. The use of coarser screens on stamp mill batteries—in effect making the stamp an intermediate crusher only.
2. To regrind this coarse product in tube mills.
3. In a later paper, they suggested that crushing be carried out in cyanide solution.

It is on record that crushing with cyanide solution through the stamp batteries was attempted in Shasta County, California, as early as 1891. It was also attempted in New Zealand in 1899 at the Crown Mine and Woodstock Mine. While the Dennys were hailed as the exponents of a new metallurgy, it may fairly be said that the metallurgy was in general new only to the Rand; but they did recognize the possibilities of treating simple ores by sliming methods to increase recovery.

B. Classification

The first cyanide plants treated tailings by percolation in vats. The reason that slime did not interfere with this percolation was that these tailings had been allowed to flow from the batteries into

a reservoir and the natural classifying action had carried off unsettled slime. When attempts to treat tails direct from the batteries were made, the first practice was to allow settlement to take place in large vats with a peripheral overflow. Various modifications of this were tried, the ultimate form being the Butters revolving distributor. Tailings were fed into a circular tank from the centre of the tank on a revolving arm—like a garden sprinkler. The settled sands were then shovelled into vats for percolation treatment.

It will be seen that this method of classification was just an attempt to duplicate the natural conditions which made possible the leaching of old tailings.

Another method of treatment involved the use of "pointed-boxes" as classifiers. These pointed-boxes were invented by Rittinger in the middle of the 19th century, and had been used in concentrating operations.

There are two main types:

(*a*) *Spitzkasten:* The pulp flows over a series of boxes in the shape of inverted pyramids. Larger particles sink to the bottom as the velocity of flow across the box is low and the slime particles are carried right across.

(*b*) *Spitzlutten:* These are just like Spitzkasten, but in addition to the transverse flow of pulp, water is introduced at the bottom to give an upward flow and cleaner classification.

The method of using these was to feed the underflow to leaching vats by means of a hose and to allow the unsettled slime to go to waste.

The function of the first classifiers was then simple—to divide the crushed product into two or more parts for subsequent treatment. Until slime treatment became feasible, this part went straight to waste. By 1896 this slime was treated by thickening and decantation.

C. Thickening

In 1894 at the Crown Reef Mine Mr. J. R. Williams worked out the first South African slime treatment. To the overflow from the Spitzkasten he added lime and the slime settled in vats. Water was withdrawn and the thus thickened pulp was agitated with cyanide solution. By 1903 the practice had changed very little, conical bottom tanks being used for thickening.

D. Agitation

McArthur's original patents suggested that stirring of the pulp would accelerate the solution of gold values, and suggested the use of barrels with revolving arms.

Agitation was not used till 1896 in general, with the exception of a few cases where concentrates were slimed and agitated. Messrs. Butters and Williams successful slime treatment schemes both used mechanical agitation of slimes. Later on, successful air agitation was very widely employed.

By 1903 the two general types of agitators were as follows:

(*a*) *Mechanical:* In general these machines were circular vats with revolving arms. A great deal of variation in the mechanical details of the arms and bearing surfaces of the central shaft was the subject of many patents, but the basic principle was essentially the same.

(*b*) *Air Lift Agitators:* This class attained much prominence during this period. The use of such agitators is credited to a company making gun-cotton explosives as long ago as 1880. The agitator was employed to give gentle agitation and yet thorough washing of the prepared explosive. The first agitator consisted of a tall tank, into the bottom of which compressed air was admitted. In 1882 Mr. E. L. Oliver, the inventor later of the Oliver filter, became manager of this company, and added a central pipe or air-lift to the tank, which greatly improved agitation. Oliver first applied this form of agitator to gold milling in 1903 at the North Star Mine in California.

Mr. F. C. Brown is however credited with being the inventor of these tanks. He first installed tall tanks at Komata Reef in New Zealand in 1902 and in 1904 added a central column.

In South Africa, W. A. Caldecott obtained patents for an air lift agitator exactly similar in principle to Brown's tanks in 1899.

Western Australia too is not without a claimant to the Pachuca tank invention. At the Kalgoorlie Mine filter-pressing was used to handle slime. The pulp was fed into tall steel tanks and then air was pumped into the top of the tank forcing pulp out through a bottom discharge into the filter press. If any delay occurred in filter pressing the pulp settled and packed the bottom of the tank. To prevent this the management tried blowing in a jet of compressed air from the bottom. A considerable increase in extraction was noted when this method was used, and from 1903 on the tanks were used as agitators.

In America this tank was patented by Grothe, and introduced

to the Mexican fields by him, where it became known as the Pachuca tank.

It will thus be seen that the problems in connection with successful agitation were comparatively unimportant, with the exception of the first few years of slime treatment. Comparatively efficient agitators were adopted almost at the outset.

E. Solution Recovery

This was the field wherein the early operators met the first difficulties. The first attempts to dewater slimes involved the use of vacuum on the ordinary leaching vat with a canvas bottom, but the great thickness of slime rendered the process far too slow.

Commercial success was first achieved in 1894 at the Crown Reef Mine by Mr. J. R. Williams. In 1896 Charles Butters employed a perfected but similar method at the Robinson Deep Mine. The solution was thickened by using lime as a flocculator and the clear supernatant liquor siphoned away from the vats.

By 1903 the following methods of slime treatment were in general use:

(*a*) *Decantation in tanks:* Decantation in tanks was universal practice on the Rand. Lime was used to flocculate and as much liquid as possible withdrawn. A wash was then added and the procedure repeated. Needless to say the method required much water and labour, but both were cheap in South Africa.

(*b*) *Filter Pressing:* A peculiar set of conditions in Western Australia led to the use of filter pressing. In a desert region, water cost as much as 50 cents per gallon. The ores were refractory and had to be finely ground, so filter pressing was introduced in 1899.

The ordinary filter press had been used by the brewers as early as the fifteenth century. It consists of a skeleton framework made up of two end supports connected by two horizontal and parallel bars. On these bars a number of filter chambers are assembled. The chambers are formed by alternate frames and cloth-covered plates. The chambers are closed and tightened by a screw which forces plates and frames together making a gasket joint of the filter cloth. The pulp is forced into these chambers which are so designed that the liquid cannot leave the press except by passing through the cloth leaving the solids suspended on the cloth. This was a simple, compact way of recovering solution, but the labour costs incident to unscrewing the press and scraping out pulp were very high. The need for some form of automatic sluicing discharge was pointed out as early as 1902.

General Observations on Slime Treatment. At this time all the operations were of the intermittent or batch type except crushing. The difficulties of the period were almost entirely in connection with solution recovery, and problems in other departments were in general of but secondary importance.

W. A. and H. S. Denny's Paper on All-Slime Cyanidation

Published in July, 1903 in South Africa, the paper suggested the use of all-sliming as a general method for cyaniding any gold ores—this was merely the introduction of Australian methods to the Rand. It evolved a great deal of discussion and controversy and produced in time basic changes in most of the South African plants.

The proposed departures from current practice were:

1. The use of coarser screens on stamp mill batteries.
2. The discarding of mechanical concentration.
3. The separation of the coarse product from stamps by hydraulic methods.
4. The regrinding of this product in tube mills.
5. The providing of secondary amalgamation after the tube mills.
6. The treating of slimes in filter presses.

The first plant in South Africa to try these methods was the Meyer and Charlton, in 1906, managed by the Denny brothers. It was quite successful, and considering this as the starting point for all-sliming, the general progress in the field will be considered under the five afore-mentioned headings.

A. Crushing

The first tube mills on the Rand were used at the Meyer and Charlton mill. The Denny brothers were early in recognizing their superiority over other forms of fine grinding devices.

In Western Australia, pioneer in tube mill usage, the question of superiority between tubes and pans was very slow to be settled. Here and in Colorado pans had the advantage that they could be used for amalgamation and to leach out soluble salts after roasting.

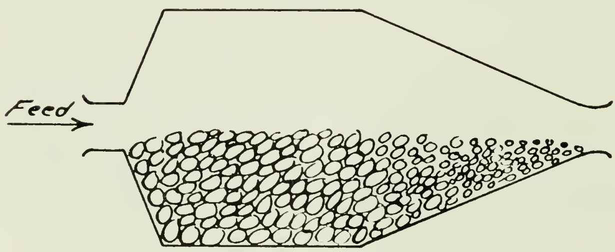
From 1906 to 1910 a great deal of the literature is devoted to discussion of tube mill liners. The first linings were silex blocks, cemented into place. These liners were imported from Europe and quite expensive, so many other forms were tried. Heavy cast iron plates were tried in Western Australia. Silex blocks persisted

in South Africa. In New Zealand and Mexico Barry or El Oro liners were developed. The general method was to line the tube mill with steel rails at intervals of a few inches apart. Silica blocks were cemented between these rails, or in another system the mill was operated in this condition and pieces of ore would become jammed between the steel rails—the mill thus self-lining. Almost every mill developed its own method of lining and the literature on this subject is profuse.

In 1908 the idea of substituting pieces of coarse ore for the usual flint pebbles was tried in Mexico. This was also used on the Rand, although the complete substitution for pebbles was never achieved.

Crushing in cyanide solution was employed in New Zealand in 1899. The Denny brothers incorporated it in their first South African plants. Its general adoption on the Rand was hindered for many years by the argument that accurate samples of the mill head could not be taken.

Recognition of the fact that tube mills were far more efficient as fine grinders than stamps involved also the idea that ore could better be crushed in stages. This was partially achieved in the Dennys' first plants when the oversize from the stamps was ground



Hardinge Mill

in tube mills. However, the question of stage grinding received considerable attention—two tube mills in series occasionally being used. The invention of the Hardinge conical mill and the sales activities of the company intensified the interest in this aspect of the question.

The Hardinge mill is an ordinary tube mill of the shape shown. As the mill rotates the large balls tend to segregate on the left, gradually tapering off toward the discharge. The Hardinge people argued that this was ideal—big balls to crush the newer feed—smaller ones to crush finer ore—a sort of stage grinding to the ultimate degree. In the light of present tendency toward cylindrical

mills it would seem that the argument has little to sustain it, but the fact remains that the Hardinge mill achieved extremely widespread use.

In Kalgoorlie where dry grinding remained in use long after other districts had changed to grinding in cyanide solution, the ball mill was commonly employed in place of stamps. The Krupp mill was the usual type and it differed from the tube mill essentially only in its larger diameter, shorter length and the use of steel balls.

Rolls remained a fixture in other camps where dry grinding was practised—usually as a substitute for ball mills in the scheme of stage-grinding. At present the use of ball mills seems commoner than rolls; probably because the gyratory crusher has reduced the size of feed so that rolls are no longer necessary.

There have since been no basic developments or improvements in tube milling. By 1913 the question of superiority between pans and tubes was satisfactorily settled—pans being suggested only for small temporary plants. About this time it was found that the use of steel balls for pebbles gave a tremendous increase in the capacity of a given mill due to the greater density of the grinding medium. This increase in capacity was however accompanied by an almost corresponding increase in power. In 1921 J. J. Denny introduced rubber linings for tube mills at the Nipissing Mine in Cobalt. These rubber liners gave a greatly reduced cost of relining and somewhat increased efficiency. The great difficulty attendant to their more widespread employment is to find a satisfactory method of fastening to the shell.

Present trends in grinding appear to be towards the use of more stages of reduction and of shorter tube and ball mills. The whole object seems to be to accomplish a reduction in any given machine between two accurately specified limits—the more nearly evenness of feed and discharge without overgrinding is attained, the more efficient is the grinding.

B. Classification

The first classifiers to be used were the previously described Spitzlutten and Spitzkasten. In modified form they appeared as cone classifiers with a peripheral overflow, and a continuous sand discharge. The difficulty with the first cones was that the discharge was irregular and the liquid to solid ratio was quite high. The next step in the use of cones was the idea of maintaining a sand bed in the cone as an essential feature of the apparatus by choking the discharge. The characteristic of such a cone is that with a

layer of sand in place the quantity of the sand discharge is almost constant regardless of head of sand. The result is that if the rate of feed to the cone be increased the sand builds up on top leaving a shallower settling zone with higher velocity of water, and more oversize is carried over with the peripheral discharge. In addition, if the sands are very fine, they tend to line the sides of the cone and tunnelling down the centre occurs till a rush of water through the discharge flushes out all the sand which will not again build up.

Owing to these two features, when used to split a ground product into two parts—one for percolation treatment—the other for slime treatment, the feed to cones must be watched very closely or the split may be so vague that proper percolation leaching is impossible.

About 1911 Dowsett patented an automatic device for shutting off the discharge from the spigot when the sand bed became low. This satisfactorily remedied the second difficulty.

The Caldecott cone, introduced in 1909 at the Simmer and Jack Mine was designed to provide more even discharge of sand. It was a simple cone into the bottom of which was fixed a circular or serrated disc leaving an annular space between itself and the walls for sand discharge. This prevented sudden slippages of sand due to building up on the sides but the attention necessary to produce an even sand product was still necessary.

It was owing to these difficulties with cone classifiers in use at the Dorr, Lundberg and Wilson in Terry, North Dakota in 1904 that J. V. N. Dorr designed the first mechanical classifier—this same classifier which is now perhaps the most widely used single piece of ore dressing equipment. The Dorr classifier consists of a V-box with a fairly gradual slope to the sides. Pulp is fed in and the settled sand is removed by a set of reciprocating rakes scraping on the incline. The degree of turbulence of these rakes gives an extremely even sand product. This was the first mechanical classifier to receive much use.

The Aikins classifier was introduced at the Portland Gold Mines in Colorado Springs in 1910. This machine consists of an inclined trough containing the pulp at the bottom. One or two rotating spiral bands are used to drag up the settled sands. In an attempt to give a sorting and stirring action required for clean sand, the spirals are made discontinuous at the bottom end of the tank. Mechanically more simple to construct, this classifier fails to give as clean a product as the Dorr.

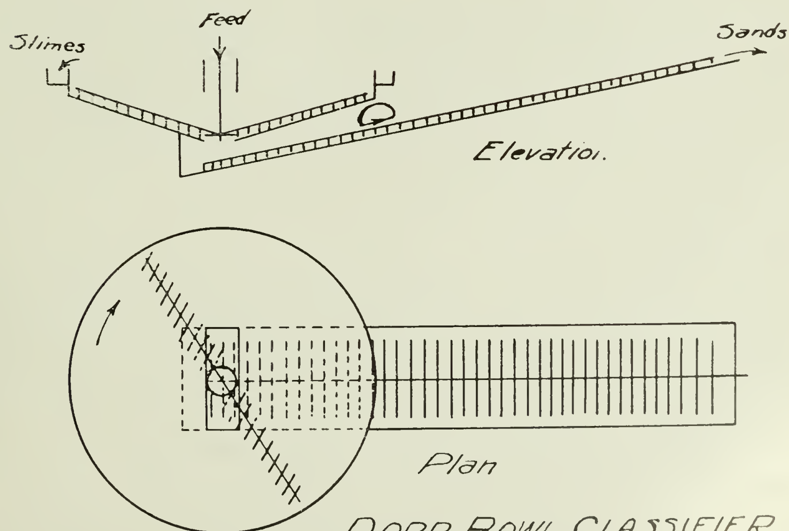
A third widely used mechanical classifier is the Federal-Esperanza or drag type, developed in 1911 by H. A. Guess and

Charles Hoyle at their respective properties—Federal Lead and Esperanza Mine. In place of the reciprocating rakes of the Dorr classifier, a drag chain with wooden scrapers was used to pull up the sand product. The spiral classifier, patented in 1913 was similar to the Aikins except that continuous spirals were used. It is interesting to note that all the successful mechanical classifiers are of American origin.

The first recorded use of closed circuit grinding is credited to Mr. J. R. Williams at the Glen Deep Mine. He used Caldecott cones in closed circuit with tube mills—the final product being cone overflow. This was in 1911 and the practice was rapidly adopted on the Rand.

When the classifier was adopted to this new function, an important advantage was added to those already to the credit of mechanical types. Satisfactory cones had a height of about six feet and this loss of head made it necessary to use some form of pump to elevate the sand feed for regrinding. Pumps for handling sand took power and at that time gave far more trouble than machines available at the present time. While cones continued to be used for many years on the Rand, elsewhere the adoption of the Dorr Classifier was almost universal. The first Dorr classifier in closed circuit was used at the Tonopah Belmont in Arizona in 1911.

The final important invention with regard to classification was the Dorr Bowl Classifier, developed at the Golden Cycle Mill in



DORR BOWL CLASSIFIER

Colorado in 1916. This machine consists of an ordinary Dorr Classifier, upon which is superimposed a small Dorr settler—the bowl. The additional action of the bowl gives a much cleaner slime product for fine grinding devices.

Modern trends in fine grinding appear to be in the direction of a very complex system of classifiers. In some cases as many as five separate classifiers are used in circuit with three ball and tube mills. Another feature is the use of high circulating loads. While the use of high circulation loads is possibly the foremost recent development, the idea is by no means new. As early as 1915, W. J. Pentland cites some of his own experiments to show greater efficiencies with such return loads in proof of "the statement one hears so frequently from engineers and millmen nowadays that the most efficient machine is the one which keeps the greatest quantity of pulp in closed circuit." The object of such a procedure seems to be somewhat as follows:

For any definite size of particle on a given ore there is a definite extraction. The economical limit to which the ore is ground is determined by the law of diminishing returns when the increased cost of further grinding is just equal to the increased extraction thus attained. To grind finer than this costs money and to leave some of the product coarser also costs money. Therefore, effort is directed to attaining just this required size. By using a high circulating load, the ore passes through the mill rapidly and therefore the extent to which any particle is overground is limited, those particles already fine enough are quickly removed from the mill and a very even sized final product of the desired mesh is obtained. To what extent money should be spent for the additional classifying equipment thus required is of course determined from a study of decreased costs of grinding attainable by the use of these high return loads.

C. Thickening

The first thickeners in general use were necessary in order that agitation could be carried on in less dilute pulps requiring smaller agitators. The general form of thickener in use was a large cone similar to the classifying cones. The difficulty with these was that slime tended to build up on the sides and they were large and expensive to construct, requiring considerable loss of head to function. While fairly successful as thickeners before agitators, they were not smooth running enough to be used for continuous decantation. When vacuum filters became practical about 1904

the necessity for thickening before filtration was further realized. Research has shown that vacuum filters do their best work with pulps containing fifty per cent or more of solids.

The Dorr thickener was the result of much research to find a better thickener and was introduced in 1908 at the Mogul Mining Company at Pluma. It consists of a large circular tank with a comparatively flat conical bottom. Attached to a central shaft an arm with ploughs attached revolves very slowly in the bottom of the tank bottom and moves the settled solids to the centre of the tank where they are discharged.

This smooth-running device is the standard thickener everywhere and was widely used from the very first. Whether filtration or decantation is employed, the Dorr thickener is used in the circuit of all all-slime mills.

D. Agitation

Although the original pachuca agitators proved fairly efficient and gave little trouble in operation, they had three serious drawbacks:

1. No matter how steep the conical bottom was made, slime tended to build up on this with the result that the narrow channel greatly reduced the efficiency of circulation and agitation.

2. The power required to operate them was high.

3. The tanks were very high and slime had to be elevated to charge them.

The Parral agitator introduced in Mexico and the United States in 1910 was designed to overcome the first of these disadvantages. Instead of a single conical bottom, the tank bottom was divided into two of four compartments—each with a pointed bottom and one air-lift pipe was used to elevate the pulp from each compartment. The tops of these liftpipes were bent at ninety degrees and discharged at the surface so as to give a swirling motion to the pulp which greatly improved the efficiency of agitation. Another type of agitator fairly prominent at the time was the Hendryx. Pulp removed from the bottom of a circular tank was pumped up a pipe by means of a revolving metal spiral. Such an agitator would work on mixed sands and slimes.

The Dorr agitator which is the type most commonly used now was developed about 1912 and the first installation was at the Hollinger Mill in Porcupine. The Dorr agitator is a simple modification of the Dorr thickener. The pulp withdrawn from the bottom is diluted and fed into the top of the settling tank by revolv-

ing arms with tap holes at intervals. The streams of liquid falling into the tank supplied fairly good aeration and the rakes revolve much faster than do the rakes in thickeners to provide agitation.

Up to 1909 agitation in any of the forms described employed the batch system. Continuous agitation was introduced in Mexico by Grothe and Kuryla at Esperanza in 1911 using Pachuca tanks. The first Parral agitators to use continuous agitation were at the Veta Colorado. The continuous method of agitation was applied to Dorr agitators at the Hollinger mill.

In Mexico in particular at this time pressure filters of the Burt type were commonly used and the head of slime necessary in a Pachuca tank was not lost but utilized to apply pressure to the filter. While modern practice is to use the Dorr type of agitator, the advantages in its favour are not great enough to warrant scrapping of Pachuca tanks in existing plants.

E. Solution Recovery

While batch decantation and filter pressing were satisfactory for solution recovery, this phase of milling still left room for the most improvement. The Moore submerged filter was a radical improvement in the field. The first Moore filter was built and tried at the Consolidated Mercur in Mercur, Utah, but owing to mechanical errors in design proved unsuccessful. The first workable Moore filter was produced by J. V. N. Dorr at the Lundberg, Dorr and Wilson in Dakota.

The Moore filter consists of a series of vertical filtering leaves attached to a rigid frame dipping into a tank containing the pulp. Each leaf is a sack of canvas stretched over a rectangular pipe frame. Suction is applied to the inside of the leaf and solution is drawn in leaving a cake of pulp on the outside. When this pulp has reached optimum thickness, a crane lifts the whole frame of leaves from the tank and drops it in a wash tank, where water is washed through. Carried to a third tank air pressure is applied to the leaves and the cake blown off.

The Butters filter was a modification of the Moore filter and was put on the market very shortly afterward. Instead of moving the leaves from pulp vat to wash vat to discharge vat, one vat was used and pulp, wash water and sluicing water to discharge the pulp were admitted in turn to the single vat, thus greatly reducing the space required.

However the Moore Company had been granted patents which they claimed gave them the sole right to use a filtering medium

under vacuum submerged in pulp, and from 1904 to 1907 every plant installing a Butters filter was threatened with prosecution for patent infringement by the Moore Company. This retarded the adoption of vacuum filtration greatly during that period. In spite of the Moore patents, chemical manufacturers particularly had used just such filters for years.

When this difficulty had been cleared up these two types of filter were rapidly adopted for slime handling, particularly in America. They were slower to be adopted on the Rand and South Africa since these countries had well established and standardized equipment already. However by 1907 filter presses were going out in Australia.

Since the maximum pressure differential across the filter medium is just atmospheric pressure when the vacuum principle is used, several types of filter were brought out which employed leaves enclosed in a tube or tank to which the pulp was admitted under pressure—in effect enclosing the pulp tank in a pressure box. A representative type of such filters is the Burt filter, introduced by E. Burt in El Oro, Mexico, in 1907. The enclosed chamber consists of a large pipe set at an angle of forty five degrees. Suspended in this pipe so as to swing freely are a series of mats around which is wrapped the filtering medium and each connected to a discharge pipe. The filtering medium is lapped around an elliptical perforated pipe. Pulp is forced into the tank under gravity pressure till a cake forms, then wash water and finally reverse air is turned on and the cake is washed out. These filters were commonly used in Mexico, but slimes tended to choke up in the cylinder and mechanical difficulties in operation were many.

The Barry filter was identical to the Moore except that the leaves were filled with corrugated metal.

Similar in general principle and defect were the Kelly and Blaisdell filter. These filters were in effect a filter press turned inside out.

The Merril filter press was developed and patented by C. W. Merrill in 1904 and first successfully operated at the Homestake Mill then under construction. This press was the answer to the problem of high labour expenses in connection with the filter press. When a cake was formed, this press employed a jet of water to wash the cake out a drainage hole at the bottom. It has been in successful operation ever since at the Homestake, where, however conditions are peculiarly adapted to its use. Its success there is largely due to the efficient aeration given to the pulp after removal

of the water used for stamp milling by blowing air through the cake. This press was used in Australia, particularly, because of previous Dehne press experience.

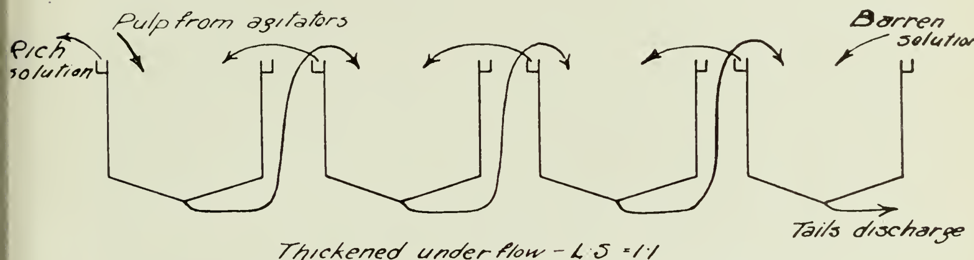
Continuous Filters: It will be noted that all of these filters are of the batch type. In spite of the fact that really good continuous filters were developed as early as 1906, adoption of them was very slow and they were even slower in displacing existing Moore or Butters.

The Ridgeway filter, developed at the Great Boulder Mine in Kalgoorlie during 1906 was the first continuous filter to be widely used. It consists of a series of twelve filter frames, arranged radially about a central axis—in effect a flexible horizontal disc of filter medium revolving in a horizontal plane about its centre. As the plates revolve they dip alternately into pulp, wash water and the cake is finally blown off with air. In order to keep the slime from settling below the filter in its tank, agitators were necessary. Its adoption was everywhere quite rapid—especially in new plants. During 1908 James estimated that one-half of all slimes handled by vacuum filters were treated by the Ridgeway filter. Possibly the reason for its adoption in preference to the simpler Oliver was due to the prevailing opinion that washing was more effective than obtainable with the Oliver.

The Oliver filter was developed about the same time as the Ridgeway, 1906 at the North Star Mine in Grass Valley, California. The Oliver filter is a drum of filtering medium protected by wires, revolving in a tank of pulp. The drum is divided radially into compartments and by means of an automatic valve air pressure and vacuum pressure are alternately applied to these segments. The cycle is as follows: vacuum pressure at the compartments immersed in pulp and at those on which wash water is sprayed when the cake emerges from the pulp—finally air pressure during the rest of the revolution till the cake is removed by a stationary scraper. This is the simplest form of continuous filter and though its recognition was slow, it was replacing batch filters in all cyanide camps by 1912. Modifications of the basic principle of the Oliver filter have appeared, some of them very successful, but it is the ultimate type of simple continuous filter. The American leaf type gives greater capacity. It consists of flat cylindrical leaves, divided as the Oliver into radial partitions with filter medium on both sides of the leaves.

Continuous Counter Current Decantation: While schemes for using large cones in series to give a method of continuous decanta-

tion had been suggested, this method of solution recovery was not utilized owing to the previously mentioned defects of cones as settlers. The Dorr settler was perfected in 1908 and counter current decantation using these machines was soon introduced. The diagram illustrates the method of using the settlers. The new pulp meets solution containing most dissolved gold and pulp moves in the opposite direction to the solution till finally impoverished



Counter Current Decantation Tanks

residue is washed by fresh solution, then wash-water. The first successful C.C.D. plant was at the Vulture Mill in Wickenburg, Arizona.

Just at this time Porcupine was coming into production and nearly all of the mines adopted this system.

Because of the simplicity of the South African ores little washing is required. For this reason, counter current decantation has not been much used. It may be said that in America, the process was almost the standard method of all-slime cyanidation for fifteen years.

One difficulty with C.C.D. is to get the dissolved values in the tailings low enough without using an excessive number of thickeners. This was recognized right at the outset of C.C.D. In 1909, Donald McCann proposed a continuous decantation system using Dorr thickeners with a Moore leaf filter at the end of the series. Apparently, however, the costs of filtration then were higher than present costs, for of this proposal he says: "The value of replacing a fourth thickener by a filter can only be obtained by noting daily gold and cyanide loss in thickener underflow. Against this can be set down the higher initial cost, maintenance and depreciation of a filter plant. Perfect washing is assumed. There is no doubt that a cheap, efficient and compact filter could be used to advantage, but it must be all that."

The use of a continuous filter to reduce dissolved gold loss in the tailings was fairly common in United States and Mexico by 1920. In 1921 the Hollinger tried an Oliver filter for washing the decantation tailings with very gratifying results. At the same time, B. D. Kelly was engaged in similar work on filtration at one of the other Porcupine mills. As a result of his research the system known as series filtration was first installed at the Argonaut Mill in Larder Lake. After preliminary thickening to the desired liquid to solid ratio for efficient filtration, the pulp is filtered and washed on a continuous filter. The cake is then repulped with barren cyanide solution and refiltered. This process has had considerable success in Canada. For high-grade ores, the number of stages of thickening required to reduce the dissolved gold loss in a C.C.D. installation may be too large. In addition, owing to the cold climate, a large heated mill becomes an expensive necessity and series filtration requires much less floor space.

Induction Watthour Meters

BY J. M. VANDERLECK

University of Toronto, Department of Electrical Engineering, March, 1937

Watthour meters are not only interesting to the electrical engineer as part of his field of work, but also to every individual engineer as part of his economics, for no matter what positions we might occupy in future years, we will always be interested in whether or not our electric bills, either in industry or in our homes, are of the correct dimension in relation to the electrical energy consumed. The accuracy of watthour meters is a very important one, not only to the engineer-consumer, but to the engineer-producer, for statistics show that a one per cent error in meter registration would cause a loss of $24,000,000 a year to central stations in the United States and Canada. Accuracy within one per cent is very difficult to achieve, because an electrical instrument such as the ammeter or voltmeter, that has more than one per cent error only below one-quarter of full scale (and which does not read above full scale at all), is considered one of the best obtainable. The loads on watthour meters make them operate mostly over a range from as low as 5% up to 400% of their full load rating; and meter engineers have re-

cently perfected the instrument to read within one per cent between these limits!

In order to describe how this is done, the elemental components of the alternating current watthour meter must be understood. The meter consists essentially of a light aluminum disc, which in horizontal rotation caused by the A.C. magnetic fluxes built up by the field poles, drives a gear train, actuating the dials of the meter. If, (*a*) the fluxes causing rotation are proportional to the power, (*b*) the torque on the disc is proportional to the fluxes, (*c*) the speed on the disc is proportional to the torque, the speed becomes proportional to the power and the dials will register energy taken by the load. However, none of the proportions stay constant with changes in current, voltage, power factor and temperature and with the presence of friction. We will deal with one thing at a time and see how compensations are made in order that high accuracy is maintained throughout the normal operating range of the meter.

The speed of the disc is kept proportional to the torque by the use of permanent magnets, the fields of which cut the disc. This arrangement is known as magnetic braking. The disc, being a metal conductor, acts like the armature of a direct current generator, which we know, requires twice the torque to make it go twice as fast. That is, the speed is proportional to the torque both with the armature of the generator and the disc of the watthour meter. The presence of friction upsets the proportionality, and thus it is essential that friction be kept as low as possible and compensated for. The way in which this is done will be described later. This settles (*c*). Now consider (*b*) and (*a*).

The torque on the disc cannot be proportional to the A.C. fluxes, for as the fluxes increase, there is a tendency for them to cause the disc to go slower through the effect mentioned in the last paragraph, that is, magnetic braking. This is taken care of by the use of alloy "magnetic bridges". Without the bridges, the fluxes causing rotation are just about proportional to the power, but the presence of the bridges causes the fluxes to become much greater than the straight proportional change with power, thus counteracting the deficiency in the torque-fluxes proportionality. The bridges do this by shorting a great deal of the normal working flux through magnetic paths which do not cut the disc, and thus this flux becomes a non-working or leakage flux. However, as the power goes up, the alloy bridges become magnetically saturated and a less proportion of the flux shorts through them, becoming a useful working flux instead. Thus, care is taken of changes in power due to changes in

voltage and current, but not in changes of power factor. In order that the fluxes causing rotation are proportional to the power with changes in power factor, the angle between the voltage flux and current flux must be 90°–(load phase angle), that is, the two fluxes must be in quadrature when the load phase angle is zero. This quadrature adjustment is made by varying the resistance of "lag loops", which are coils wound so as to encircle a path of the working flux of the voltage element (field piece). These shorted turns set up large reactive fluxes, thus causing the voltage flux to lag more or less, according to adjustment, until the correct angle is reached.

Now, a rise in temperature increases the resistance of the electrical conductors and the reluctance of the magnetic paths, upsetting all the values of fluxes and the quadrature relation. Compensation are effected by dividing the various factors causing temperature errors into two classes.

Class I. Those that affect the magnitude of the driving or braking flux.

Class II. Those that affect the quadrature relation between the voltage and current fluxes.

All errors caused by class I factors are eliminated by mounting the permanent magnets on "magnet supports" which are studs of thermal responsive magnetic alloy, whose permeability varies inversely with the temperature. They provide leakage paths for the fields of the magnets so the tendency for the meter to over-register with an increase of temperature is counteracted by the decrease of permeability of the paths, thereby forcing would-be leakage flux into useful braking flux through the disc, keeping the speed constant with temperature changes.

All errors caused by class II factors are eliminated by using "thermal wedges" composed of temperature responsive magnetic alloy, and placed in the flux paths of the lag loops. The tendency of the quadrature relation to decrease with higher temperatures is compensated by the decrease in permeability of the thermal wedges, which now allow more reactive flux to be generated by the lag loops.

Friction is the only factor left to consider, and it has been the most difficult obstacle to overcome, since it could not be made to stay at a constant low value over a reasonable length of time. Friction is caused by the gear train, by the upper and lower bearings of the vertical spindle of the disc, and by windage due to the rotation of the disc in the air. By proper design, the friction can be reduced to a very low value, but nevertheless, it is present and must be compensated for. Since it is practically constant over the normal

working range of the meter, a "light-load vane" is used which can be adjusted to give a small constant positive torque to exactly counterbalance the constant negative torque due to friction. The vane consists of a small flat piece of copper which is placed in the magnetic field along with the disc, to act on the flux from the voltage element. The copper acts like a shorted turn, and if it is placed to one side of the voltage pole piece, reactive fluxes are set up here which make the flux from one side of the voltage pole piece lag the flux from the other side. This has a similar effect on the disc as the combination of the working voltage and current fluxes, that is, it provides torque. The torque is almost a constant one because the vane acts on the voltage flux which is practically constant because the line voltage varies but little.

Now if the friction in the meter grows with time, the meter will under-register until the light load vane is readjusted. However, if the friction in the meter rises extremely or jumps up and down during each revolution of the disc due to, say, faulty bearings, then the meter reads inaccurately and nothing can be done about it except to exchange the defective part. The gear train and upper bearing are not difficult to design so that this does not occur, and of course, no trouble is given by the windage friction in this respect. However, in the lower bearing, the stresses are so high that frequent inspection trips must be made to replace the defective ones.

Many research workers have spent a good deal of time on lower bearing investigation, only to obtain contradictory results due to the complexity of the problem. The bearing itself appears simple, for it consists of a pivot resting in a jewel cup. If the torque due to friction is to be kept as low as possible, which is essential, the pivot must have a bearing area on its point no larger than that to cause less than maximum bearing stress before failure of the material occurs. Thus the pressures in the bearings are no less than 20,000 pounds per square inch and sometimes greater. Rotation under this extreme stress causes phenomena to occur not found under any other conditions. For example, it was found that platinum (a material which is normally unattacked by atmospheric conditions and when used as an anode in electrolysis) is used as a pivot material on a dry sapphire (composition Al_2O_3) jewel, a copious fawn-coloured non-metallic debris is produced at a low speed, and at a higher speed and greater pressure, a black debris is formed, both of which appear to be oxides of platinum. It seems that when any pivot rotates, a lot of debris is formed, either from the pivot, or the jewel, or both. With steel pivots in sapphire jewels, which, by experience, give the

best performance for the cost, large quantities of rust form around the bearing surfaces. The rust acts as an abrasive and is capable of doing serious damage to both pivot and jewel.

Oiling the bearing decreases the rate at which rust is formed, but even complete oil immersion does not stop the formation. This led investigators to believe that the oxygen in the rust was derived from the sapphire (Al_2O_3). However, experiments with other jewel materials would just as often contradict the theory as confirm it. Tests show that oil does not decrease the initial friction, but it does allow the bearing to run about thirty times as long before friction rises abruptly to a prohibitive value. Under typical bearing pressures, even when the pivot rotates, no oil film exists between the pivot and jewel over a small area. This explains the small rise in friction when the dry bearing is lubricated, for the oil does not reduce the friction by forming a slippery film between the surfaces of contact, but it increases the friction due to its viscosity and resultant drag on the rotating pivot. The oil merely increases the life of the meter by distributing the rust and debris formed throughout the oil film. Thus the harmful abrasives are kept away from the rubbing surfaces. But the trouble with lubrication is that if animal and vegetable oils are used, in a short time they gum up, become rancid, and acid is formed which attacks the pivot material, forming rust in the case of steel pivots. On the other hand, if mineral oils are used, due to the surface tension of the oil on the bearing metal, they spread themselves over the parts around the point of lubrication, finally creeping away until the complete works are covered with an infinitesimally thin film, while the pivot itself runs dry.

Further bearing troubles were found due to the wear or cracking of the jewel. Once the jewel becomes worn or fractured, the friction becomes extreme, and thus research workers looked for the best possible jewel. Diamond, being prohibitive due to cost, was displaced by sapphire, the next best. However, like diamond, a sapphire jewel causes different amounts of wear to itself and the pivot, depending upon the orientation of the plane working surface relative to the crystalline structure. This point was neglected by many investigators due to first, forgetting about it, and second, the difficulty in either determining the orientation, or obtaining jewels with a specified orientation. Thus results obtained on all phases of bearing work such as the effects of various oils, speeds, pressures, pivot materials, pivot shapes, etc., became of little value, because every different jewel gave different results.

The situation drew more and more attention because the meters became practically perfect in their performance with the improved compensations (mentioned at the first of the paper) with the exception of the lower bearing, which was so unreliable that every one of the millions of watthour meters in houses and factories had to be inspected frequently to replace defective bearings. Improvements came slowly, an important one being "epilaming", or the "Woog Process", which consists in covering the parts with a substance which obviates the effect of the surface tension of the oil on the metal so that mineral oils could be used for lubrication. Also, the sapphire jewels gradually became more and more improved with better technique in manufacture. Then, again, very recently the research laboratories of one of the meter corporations developed a non-ferrous alloy of the molybdenum group, "alloy number 43", which is used to tip the steel pivots. This forms practically no debris with lubrication, but the performance is not perfect with a dry bearing. Thus a new alloy of the platinum-iridium-rhodium group has been perfected which promises to give service at least equal to that given by the other component parts of the meter. When this alloy is used in the bearings of every watthour meter, the saving in inspection trips will not only favour the engineer-producer of electricity, but will be reflected to the engineer-consumer as well.

Acoustics

BY W. J. HODGE

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(Adapted from an address to the University of Toronto Engineering Society, January 15, 1937)

We live in a world of sound. Our ears are recording sounds every minute of our lives, as Nature has provided no means by which they may rest themselves while not required. For that reason we should protect them whenever possible, for our sound world is full of a conglomeration of noises which works a positive harm to those who must suffer its attacks. The science of sound used to be a subject of interest only in the lecture hall and the laboratory. We have recently awakened to its importance mainly because of the clanking, screaming uproar of a berserk machine age.

The Production of Sound

Wherever and whenever a vibration occurs, be it in the string of a piano or violin, a column of air in an organ pipe, or the diaphragm in a telephone ear piece, the stage is set for the creation of sound waves. The actual effect of the vibrations is to cause the molecules in the air to move forward and back along straight lines radiating out from the vibrating object. Thus alternate waves of compression and rarefaction move out from the sound source, although each molecule merely vibrates through its original position. The distance one molecule moves forward and back is the amplitude of the wave, and the speed with which it moves provides the frequency.

These vibration waves in the air reach the ear and push against the ear-drum, causing it to vibrate in a similar fashion. On the other side of the ear-drum a jointed, bony structure transmits the vibrations to an inner membrane. This is connected to the nerves and these carry the impulses caused by the vibrations to the brain. Not until this time are we conscious of a sound.

The loudness or intensity of the sound is caused by the amplitude of the wave. The pitch of the sound is determined by the frequency. The quality of the sound is determined by the harmonics or overtones produced. This is why the tone of a saxophone differs from that of a violin. All voice and musical sounds are rich in overtones. The greatest problem in acoustics is the preservation of these in an undistorted form.

The Need for the Acoustical Engineer

In this modern world sound forces its way into everyone's consciousness. Nearly every outstanding invention of modern times has left a wake of new noises—the radio, automobile, steam-engine, trolley-car, electric refrigerator, typewriter, sewing-machine, printing-press—the list is endless. About the only important noiseless invention of modern times is the electric light. Thus noise in its countless aspects is continually raising problems. For example: How can employers capitalize on the benefits of modern office machinery without compelling their employees to work in conditions of distressing noise caused by them? Again, how can residence interiors be protected from exterior street noises and from the various miscellaneous sounds that domestic equipment generates?

Just how conscious the public is of noise can be seen by reading the advertisements in any magazine. You will find many that feature the words "quiet" and "silence". The physiological effects of

noises on human beings are considerable. It has been determined that sudden noises cause a rise in brain pressure and an increase in blood pressure and the rate of respiration. They also impair the digestive system by reducing the flow of saliva and gastric juices. Thus it is not accidental that we seek the quiet places. Noise does take its toll on us.

Measurement of Sound

Noise is aptly defined as "undesired sound". At one time all sounds not pleasing were termed noises, but this definition is open to exception. Even the cadence of a Wayne King waltz can be noise if it emanates from a neighbour's radio at three o'clock in the morning.

In an effort to compare and classify sounds, acoustical engineers have a scale for measuring the intensity of sounds. It is built around a unit of sound intensity, the decibel. A one decibel change in sound intensity corresponds roughly to the slightest change in loudness that can be distinguished by the human ear. The decibel scale range is 0-130 and it is very comparable to the ordinary thermometer scale. Zero on the scale will never be encountered. In a room with this intensity reading, you could actually hear your heart beat and the blood rush through your veins. The lowest we have ever gone is 10-15 decibels. The other end of the scale is often reached. One hundred and thirty decibels is known as the threshold of pain, and if your ears are exposed to this intensity for a short time they will be ringing for several hours after. Table 1 compares the decibel scale or "noise thermometer" to sounds met in ordinary life.

Table 1

Decibel reading	Produced by
130	Threshold of painful sound
120	Artillery gunfire
110	In airplane cabin
100	In subway car
90	Average auto horn
80	Tabulating machine room
70	Average stenographic office
60	Average general office
50	Average quiet office
40	Average residence
30	Quiet farmhouse
20	Underground vault
10	One's own heartbeat
0	Absolute stillness

Sound intensities are recorded in decibels on a noise-meter or acoustimeter. Acoustical engineers have used it for some time, but it has lately come into public notice over one of the nation-wide radio broadcasts and is known as the applause-meter.

Sound Absorbent Material

Acoustical problems in architectural design are caused by what is known as reverberations. These are the reflections of sound waves from surfaces. Hard curved surfaces forming the walls and ceiling of a room are excellent conditions for their production. In an ordinary room the reflection of sound from one surface should not dominate any other. However, you see many theatres with a curved back wall opposite the stage. The effect of this curved wall is to concentrate reflections of sound to a point in the audience where ordinarily you would find the best seats. Also many theatres have a curved surface from the top of the stage opening to the ceiling. Again, this concentrates sound reflections to some point in the audience. Here you would hear the original sound coming directly from the sound source and then a decided echo or prolongation of the sound reflected from the curved surfaces. An acoustical engineer will recommend that either these surfaces be straightened out, or they be covered with sound-absorbing material. In this way the concentration of reflected sound waves would be eliminated.

Sound absorption material is now being widely used in acoustical problems of this kind with satisfying results. Rock wool and felt are common types of sound-absorbing material. The sound waves become entangled in the material and the energy is thus dissipated The reflections of the sound lose a large part of this intensity. The thicker the material is, the more effective it is, as it will absorb a wider range of frequencies.

The efficiency of this material is rated by a coefficient which is the percentage of sound absorbed from each vibration. All common-building materials have been given a coefficient. Rock wool has a coefficient of 83 at 512 cycles. Some hard surfaces, as wood floors and panels, peculiarly are effective absorbers of sound.

To be practical, the sound-absorbing material must have a wearing surface that can be washed or painted. This can be done by covering the soft absorbent material by a perforated metal sheet. This combination will have as high an absorption coefficient as will the aborbent material alone, although the general public find it hard to believe. They think of sound waves as they would of arrows that may strike the perforations and be absorbed, or they may strike the

metal and be reflected. This is not a true representation. Sound waves are pressure waves. They quickly fill an ordinary room and subsequent waves build up a pressure. Then, just as water through a sieve, the sound waves will pass through the perforations and will be absorbed by the soft material.

Sound-Proofing

Another application of acoustics is the sound-proofing of rooms and mechanical equipment. Sound-proofing is the isolation of sound to its point or room of generation. Sounds pass from one room to another by vibrations in the structure. These can be eliminated if a discontinuity of the structure is imposed in the path of the vibrations. In structures this is done by actually building a room within a room. The outer one may be of ordinary soild building materials as cement and tile, the inner room has walls and ceiling of lath and plaster and a floor of wood. It is tied on to the outside structure by "isolators". These isolators provide three thicknesses of absorbent material that the vibrations must pass through before they reach the outer structure. The light walls of the inner room vibrate easily and tend to dissipate the energy of the vibrations in this manner. What vibration energy is passed on, is dissipated in trying to pass through the absorbent material of the isolators. Machines may be sound-proofed in the same way. They are put on a platform that is supported only by a number of isolators. Very little of the vibrations pass on to the floor of the room.

Reverberation

Let us return to the reflection of vibrations within a room. Although sound travels at a velocity of about 1,100 feet per second or 750 m.p.h., it is the slowness of this velocity that causes acoustical problems. The reflection of a vibration reaches the ear a perceptible interval after the original vibration, causing a prolongation of the sound, or a reverberation. The length of time for an ordinary sound to die away to inaudibility is the period of reverberation.

Many rooms have a reverberation period of four to five seconds. Speaking at an ordinary rate of four syllables per second, a person would speak twenty syllables before the sound of the first one would die away. Certainly it would be an impossibility to understand the speaker clearly. It is not possible to speed up the velocity of sound, so our only other resource is to reduce the reflections by sound absorbent material. The absorption coefficient of the ordinary room is 3 and 97% of the energy of the sound waves is returned in the

reflection. By putting a sound-absorbent material around the room, the coefficient will be raised by 50-90. The period of reverberation can be cut to less than one second. This is the most common method of meeting this problem. There is a formula that can be applied to find the period of reverberation in any room.

$$t = 0.05 \frac{V}{a}$$

where t is period of reverberation in seconds for any standard sound,
0.05 is a constant for standard loudness,
V is volume of room in cubic feet, and
a is the absorption coefficient of all the surfaces and objects in the room.

A reverberation period of less than one second will make voices soft in quality and they lose their life. Thus the best period is a compromise being the shortest period possible without taking away the live qualities of the voice. For speaking, the best period is about 1½ seconds. Music must have a longer period for proper rendition. Broadcasting studios demand a special study because of the wide range of frequencies used. The better studios use material four inches thick in the walls of their rooms.

Use in the Commercial World

The harm which noise does to the human mechanism is by no means a matter of guesswork. One set of experiments showed that typists used 19% more energy and lost more than 40% in speed working under noisy conditions. And here is something interesting from the common viewpoint of all business—efficiency and economy. An installation of quieting treatment in a telephone room of the Western Union Company reduced the number of errors made in handling messages by 42%; a net saving of 3% in the cost of each message resulted. In another installation in the bookkeeping department of a large department store a reduction in errors of 24% was effected.

In the laboratory there have been discovered principles of new and revealing importance regarding sound. We know its cause and effects, its results when suppressed and when out of control. Great resources and engineering ability are now at hand to provide quiet for all who realize the need for it and will demand it. When the benefits of sound—*controlled*—are realized, then noise, the greatest scourge of modern times, will be doomed.

"Two Thousand Jobs"

From an address delivered before the Engineering Society of the University of Toronto, February 11th, 1937, by R. E. Smythe, Director, Technical Service Council, 2 Grosvenor Street, Toronto, Ontario.

A few months ago, the name of an engineer from this University was written into the records of the Technical Service Council as having obtained employment. There was nothing unusual about this, except that the man happened to fill the two thousandth job arranged by this organization since its inception in June, 1928.

It seemed to be a good time to review these placements to see if some general information could be gleaned from them that would be of value to those about to seek employment, and to Universities in shaping their courses. Due to the quickening of industrial demand for men, this survey has not yet been completed, but there are some general observations that can be made, and I hope they may be of interest.

A Subdivision of Jobs

All jobs appear to fall into one of three broad classifications, technical, administrative or sales. It may be that a fundamental technical knowledge is required in all, but a predominant ability in one of these fields is the deciding factor in employment.

By "technical", is meant jobs which involve skill of brain and hand, such as that required for design of all types, for testing, assaying, analyses, research, development, scientific control, geology. These are jobs which may not require much supervision of people, but they do call for high technical skill.

By "administrative", is meant jobs which involve the direction of people, or control of materials, such as time study, scheduling, production planning, shift boss, traffic control, and in general, co-ordinating the work of others.

By "sales" is meant the distribution of goods, and education of the consumer into the merits and uses of the product to be sold. This naturally calls for the ability to meet and deal with people, without friction.

Thus, when an employer is looking for a man, back in his mind he is thinking of certain abilities which the man must have. These abilities are usually related to the three general classifications—technical, administrative and sales, as just described.

For example, some two years ago, a manufacturer of waxes asked us for a Chemical engineer. He wanted a man to take charge of his laboratory, to analyse incoming materials and exercise technical control over processing; but he stated that the man he was seeking was to be factory superintendent at the end of two years. Therefore, while he needed immediately a man with good technical ability, he had to have one who would develop into a leader and take over the entire administration of his plant. The man, who was at that time chosen, told us recently that he had been made plant superintendent, and that the promotion came as a surprise. The company, when employing him, had not indicated to him what their future plans were.

It can be clearly seen that the main requirement for the job was a strong administrative ability; high technical qulifications alone did not interest this employer. He was looking for a future plant manager, not just a chemist.

Choice of Employment

Now if employers seek men for these three general types of work, it seems only reasonable for a man studying in University to consider in just which of these divisions he would be most successful, and then to choose work that would lead to that field. This may not sound easy, and yet most men really do it when they accept their first job. They are then taking two steps in one; they allow an immediate opening to influence their decision as to their choice of work, when they should come to a conclusion as to the type of work they wish to follow, and then work toward getting a job in that field.

Thus, a man must make up his mind which field of work he is going to enter, and it must be done with regard to training, ability, character and health or handicaps. How is a man to know for which work he is best suited? In making such a survey, a man's outside interests should be taken into consideration—his extra-curricular activities, such as sports, offices held, hobbies, as well as the ability he has shown in his scholastic work. Then, it might be possible in the summers to do some experimenting with various kinds of jobs. The opinion of experienced men can be very valuable but it will be found that men who are most capable of giving advice, are reluctant to do so. They will give information gladly, but do not like to take the responsibility of influencing the life work of another. The final choice must be made by oneself.

The other day, in an interview with a young mechanical grad-

uate, I asked which type of work he was seeking; whereupon he replied: "I was the worst draughtsman in my class, I barely made my Degree, I have never administered anything, and most certainly I could never sell."

What was his difficulty? He had never thought about his future work in a concrete way, or made tests of what his ability might be. Obviously, if he was not good at anything, he was bound to have great difficulty in obtaining a job. He did, however, have certain abilities, which he had not considered objectively in relation to his future work. It was apparent that he had a sense of humour and a gift for getting along with people, as well as other qualifications for sales work.

Is There a Right Decision?

So many men ask which is the right job, and perhaps a little light, of the philosophical kind, can be thrown on this problem. It seems to puzzle the man of forty-two as well as the man of twenty-two.

There are a great many uncontrollable factors—the future is full of uncertainties, and cannot be predicted.

After a great deal of observation, I am convinced there is no *right* decision, just *a* decision. There is no absolutely right job for you. If you choose as intelligently as possible, it is all you can do. Once you make a decision, dismiss the alternatives from your mind, and give your job a fair trial.

Effect of First Experience

It is fairly obvious that first jobs influence subsequent careers. One engineer of fifty years of age came to us recently and sought employment. He had been graduated in chemistry, but had twenty years construction experience. When asked about this, he explained that he had taken the first job he could get after graduation, and it happened to be on construction. He decided to work at this until he repaid some money he owed. After a few years, he married, and then found he could not obtain a starting job in a chemical industry without reducing his salary, which he could not afford to do. He is still in civil work. This is the result of a first choice; the years slip by, employers will pay only for applicable experience, and to change later is most difficult.

If you were an employer and were seeking a man to take charge of your factory, say, manufacturing rubber products, would you select a man who had been in sales work, or one who had been on

construction? No, you would naturally select a young man who had the necessary background of experience in rubber manufacturing. So it may be concluded that it is advisable to build up early experience so that its effect is cumulative; experience becomes more saleable, in this way, and at a higher figure.

Should a Graduate Purposely Change his Job during First Years?

The answer to this question depends on your plan for building up your experience. Many mining engineers would say, "Yes, a man must obtain breadth and diversity of experience." Consultant engineers would probably agree, and say that wide experience is essential. Suppose, however, we ask a telephone company their opinion. It is a highly specialized business, and there is a high cost of training involved, and a considerable time element. Then, too, experience gained in this industry is not easily applied to other businesses. Hence, a man entering such an organization should be prepared to stay with it; and these same factors apply to many other industries.

There is also a definite disadvantage in changing jobs too often, as future employers are inclined to wonder why it has been necessary, believing it is an indication of instability or poor judgment on the man's part. From an employer's point of view, also, it must be very discouraging to train men in various parts of a business, and then have them resign just when they are ready to assume some responsibility.

The Employer's Point of View

The average employer is a very human individual; some drive with a tight rein, others may have unusual ideas, but in general, they are serious, hard-working men.

The man who is managing a business is responsible to a very observant board of directors, and has to carry on the business to their satisfaction, which usually means a good return on investment. At the same time, he must keep his employees fairly well satisfied. Needless to say, this is not the most happy position, especially when the value of the dollar goes up and down and complicates the balance. But rest assured of one thing, he just *has to have* competent men working for him, and in general, he pays them fairly well.

This business man looks at the University and is sensible that a good many of his future assistants are about to graduate. He

feels, however, under no obligation to employ university men unless he needs them, and can offer them a reasonable return in the future. He does not ask you to go to college; you take that step, so if too many happen to choose the same course in any one year, it cannot be blamed on the industry if employment is difficult to obtain. The employer is hardly responsible for the competitive system, or for the numbers graduated. He does have to have dependable, reliable and long-headed men to help him, but how is he going to make that selection?

Some companies have several men interview applicants, and then compare notes. They select the man who rates highest in their collective opinion. Other companies trust one experienced man to do the employing. One man who employs for a large company gave these as his specifications: the man must be able to write and speak English well; must be a man who finishes what he starts; must be above the lower third of the graduating class; must have a sense of humour, and be of good appearance. It is probably well that different employers have different ideas. Another company we know will only accept honour graduates, and in addition, usually demands some other outstanding ability. Most employers place a great deal of weight on the written application and the accompanying letter.

Application Forms

It is well to take ample time and write an application form out very completely. Answer all questions that concern you fairly and frankly, and do not omit early experience, no matter how simple it is. I remember one man who carried a paper route all through his college course, and conducted a refreshment booth in the summer. When an industrialist discovered this, he gave him the preference, stating that he could give him the experience necessary, but could not give him the courage to attempt things on his own. The fact that he had never missed one morning in four years of delivering papers seemed to clinch the bargin, as it indicated dependability.

Dependability and Its Results

In closing, I wish to make a plea for absolute dependability in your dealings with employers. It not only influences the result to the immediate applicant for a job, but it affects the attitude of employers towards all graduates.

One industrialist told me recently that he would not interview

any more men of the graduating class because of this factor. It seems that his company were negotiating for another plant, and if their offer was accepted, they would have required an engineer. He therefore gave every man an interview who called seeking employment. Within a month, six men had filed applications, but when the time came for the employer to write the applicants about coming in again, he got the following results—three men did not reply at all; two replied after a lapse of several days; one only had previously withdrawn his application. He had wasted the whole time he had spent in giving these interviews.

I suggest, therefore, that you let the employer know that you are business-like; that you mean what you say. Cancel all other applications when you do accept a job. Treat an application as the most important piece of business you do—it probably is. Then you will find a warmer welcome whenever you offer your services.

Stereoscopic and Aerial Mapping

Adapted from an address by Col. E. L. M. Burns, to the Engineering Society of the University of Toronto, November 25, 1936

The science of producing maps from air photographs, although practised only since the Great War, has undergone a tremendous expansion and already 375,000 square miles of territory have been surveyed in this manner throughout Northern Canada.

The plans prepared from aerial pictures are superior in many respects to those that are prepared by ground traverse. Primarily, because the photographs are far more comprehensive, embracing practically everything the eye can see. In addition the pictures furnish a permanent record of information that might be called upon at any time for reference.

There is very little technique required to utilize the information on a picture taken at right angles to the earth over a flat country. But this is not usually the condition and the science of photographic mapping lies in the correct extraction and application of the information on these photographs.

In general there are two methods of taking pictures from the air. The one method being known as "oblique photography", the other as "vertical photography".

Oblique Method. Under many flying conditions an aeroplane

has such unstability and irregularity of path that the aerial camera cannot be oriented by use of a bubble-tube and since the line of sight should be less than three degrees from the vertical to give accurate enough results, this becomes an important problem. To overcome this difficulty, the photograph is taken at an oblique angle to the earth's surface and generally includes the apparent horizon. The resulting photo has large scale as well as angular distortions. That is, a millimeter in the foreground represents much less distance than a millimeter near the horizon. In order for the picture to be of any practical use it must be divided into a series of squares that represent the same area at all parts of the picture. The squares have not right angles due to the slant and perspective of the picture. The material on the oblique photo is then converted into a true plan by means of a machine known as the high oblique plotter. This instrument employs a microscope with a set of cross-hairs to trace the photograph when viewing. The motion is automatically corrected for the distortion of the picture and by means of a mechanical moving pencil can be transferred to a true plan.

Vertical Photography. Very slight irregularities of flight are noticed at greater than 8000 feet with the result that aeroplanes flying at these altitudes with gyroscopic Robot pilots are fairly steady. In these cases the camera can be properly oriented and pictures taken quite accurately shooting straight down.

Distortion Due to Height Difference. When a group of tall buildings are vertically photographed, the structures at the edges of the resulting picture appear to be falling away from the centre. The net result is that the top of the building in the picture is *not* above its base. Hence a photograph containing a high building on a hill would give a distorted impression of its actual location. Only at the centre of the picture would there be no distortion and the top of the building would appear vertically above its base. This phenomenon means that in order to construct a map of the area in question it cannot be merely traced but some method must be devised for interpreting the information contained in the picture. This problem has been solved by use of the stereoscope.

Stereoscope. The stereoscope is the instrument that graced grandmother's parlour and through which people saw pictures in third dimensions—that is with real depth. This is achieved, briefly, by taking two photographs at a fixed distance apart, representing eyes, and viewing those pictures *one with each eye.* That is, the picture taken by the camera on your left must be shown to, and only to, the left eye; similarly with the right camera and right eye.

In this way an actual scene is reproduced, giving the effect of third dimension.

In aeroplane photography the pair of pictures are not taken the distance apart of the eyes but sometimes thousands of feet apart to give a highly exaggerated sense of depth. Instead of having two cameras a thousand feet apart, the same camera takes pictures repeatedly as the plane speeds along on as straight and as level a course as the pilot can manage. Then each picture is a mate to the preceding one to give the stereoscopic effect. There must be overlapping of course to give depth perception.

Multiplex Aeroprojector. To view the results of these photographs the multiplex aeroprojector is used; this consists of a series of nine magic lanters set up on a horizontal bar, pointing down on a table. The lanterns have slides of the successive pictures and the lenses are alternately filtered red and green. Then when you look at the result with red and green glasses the pictures meant for each eye are automatically selected and the effect of third dimension is obtained. Then when the pictures are all adjusted properly the required information may be taken off.

"*Picture Orientation.*" A rather ingenious method is used of adjusting the pictures so that they faithfully represent the positions of taking. This is necessary, otherwise the information cannot be accurately taken off the pictures. Therefore, it is not sufficient to fix the position of each pair of red and green pictures so as to *appear* conformable to the eyes, they must be *actually* over each other. When a red and a green picture are superimposed and viewed with red and green glasses, one image appears in each eye. And if a point in one picture is not actually over the corresponding point in the other picture the eyes accommodate themselves to this discrepancy. But to be mounted correctly each point must be exactly over its corresponding point in the next picture. To accomplish this an illuminated spot is made on the table in the same plane as the point under consideration. Both eyes see this spot, but when the eyes are looking at the points not coinciding in the photograph, the optic axes of the eyes diverge to accommodate this point as one, and in doing so the illuminated spot appears as two. Conversely when the illuminated spot is concentrated upon the point under question appears as two. The way to superimpose the points in the photographs is to concentrate on them and adjust the pictures until the apparently twin illuminated points become as one. When the photographs are in adjustment the plane of any point may be determined similarly. If a point in the picture is

concentrated upon the illuminated spot is moved toward and away from the lantern until it appears clear, and as one spot. It is then in the horizontal plane of the point and represents the altitude to the determined scale.

There are six adjustments on each projector to obtain the proper orientation in projection. Three correspond to the x, y, z, directions and the other three duplicate the tilt dip and swing of the aeroplane.

These foregoing adjustments orient the lanterns or pictures with relation to themselves, that is, orient the pictures along the line of flight but now the pictures must be oriented en masse to obtain the proper relation of the line of flight to the ground. This is done by matching on the table (or screen) three known points in the photographic survey with these same points which have been fixed by ground survey. Now the photographs are all correctly oriented and are ready for plotting.

Plotting. When the stereoscopic pictures are projected on a table, the result is in three dimensions and is not flat or flush with the table and on that account cannot be merely traced. But we have observed before that high buildings appear to fall over, radiating from the centre. The centre is the principal point of the photograph. Therefore, if we draw a line from the centre through the top of a hill, and in the next photograph draw a line from the centre of that picture through the same hill-top, then the intersection of these two lines is the true position in plan of the hill-top. Since the centre of the picture is called the principal point, this method is called the "Principal Point Traverse." In this way the three dimensional photographic survey is reproduced in plan on paper.

"The Engineer who is not an Engineer"

Adapted from an address by N. F. Parkinson, of the Falconbridge Nickel Mines, to the University of Toronto Engineering Society, December 11, 1936

You are all taking your training to prepare you for an Engineering vocation and the particular part of the University which you are attending for this purpose is called "the Faculty of Applied Science". The word "Applied" means something and distinguishes the type of training you are receiving from what we may call pure science. When you have completed your training you will probably be told what most of the rest of us were told in the old days by our then highly respected Dean, John Galbraith, that we should disabuse our minds of the idea that we were going out into the world as Engineers and that, on the contrary, we should realize that all that had been done for us at the School was to prepare us, so that we were able to commence our studies intelligently along such lines of endeavour as we might follow in future.

You too, at that time, will have to make the decision, or probably in many cases will have it made for you by circumstances, as to what form of activity you will follow. I say this because while you all have had in mind certain preferences for some branch of Engineering, as evidenced by the course you have selected, and while you may also have had some further preference for certain specialties within that branch, the opportunity for employment that may present itself to you immediately on graduation may be a more important factor in deciding the course of your future efforts than your present views and wishes. Even after decision is made, changes in your personal employment, changes within your industry, changes in methods or even national changes—such as wars—may necessitate still further adjustment of your own plans; so that for still another reason your education is never finished.

Just to indicate to you what has been the experience of previous graduates, I have obtained some figures that you may find interesting. From the last information available, graduates in Mining in the years 1921-22 for example, a total of 25 men, are at present engaged as follows:—

In mining		17
Outside of mining:		
Sales engineering	2	
Insurance	1	
Utilities	1	
Manufacturing:		
Soap	1	
Underwear	1	
Food products	1	
Teaching	1	
	—	8
		25

As a matter of fact, for the reason that mining in Canada is at present so active, that is probably the course in which a higher percentage will be engaged directly along the lines of their training than in almost any other course that may have been taken for the past few years.

I obtained from the secretary of the graduating year of 1923 the following figures applicable to all the courses represented in that year. The positions held by 121 of the 293 graduates are known. The occupations represented are as follows:—

Directly engaged in line with their courses:	
Engineers	39
Architects	4
Assayers	1
Contractors	3
Geologist	1
Roadmaster	1
Surveyor	1
Executives through technical positions	25
Total	75 or 62%
Occupations allied to training:	
Sales engineers	5
Teachers (50%)	8
Total	13 or 11%
Engaged in other occupations:	
Auditor	1
Broker	3
Coal dealer	1
Executives	9
Farmers	2
Insurance	2

Jeweller	1
Lawyers	2
Newspaperman	1
Secretary	1
Soldiers	3
Teachers	7
Total	33 or 27%

My classification may not be entirely accurate or be entirely in accord with some of the remarks I make later on, but it is the best I can do in the circumstances. For example, of the 34 men listed as holding executive positions, I have included 25 amongst those engaged directly in line with their courses because I am informed they came to these executive positions through technical branches of their respective industries. In addition, I have shown about 50 per cent. of the teachers as engaged along the lines of their courses, although here the division is entirely guesswork. It may be also that the lawyers deliberately combined their technical with their legal training in order to be equipped to deal with special problems in law. However, the figures developed will serve to illustrate my remarks, even though they may be subject to some correction.

At this stage I am not going to deal further with the graduates engaged in occupations outside of the specific courses which they took, but I want first to generalize a little further.

The engineering graduates, determined to seek and retain employment in strictly engineering fields, are in the main restricted both as to the opportunities for employment and as to advancement in their several lines. In industry, for example, a graduate in Civil, Mechanical or Chemical Engineering who wishes to remain strictly technical is limited largely to research or detail work. This limitation also applies to many other branches of engineering, even, for example, to mining, where probably the field of the engineer is broader than in almost any other branch.

The mining engineer in his ordinary progressive advancement does look forward to managing at least an individual property.

Apart from the above two general fields of engineering open to the engineer who wants to stay with "technical" engineering, about the only field of endeavour open to him is that of teaching.

The purpose of my talk is not for a moment to try to discourage any man from taking a course in any branch of Applied Science; on the contrary it is to do just the opposite. But the point I am trying to make is that for the purpose of taking full advantage of the op-

portunities that will offer, the engineer must be prepared to go farther afield than might be anticipated by the title of "Engineer" which he acquires as a result of his preliminary training and later work. To do this, however, he must be prepared to broaden the scope of his activities and study from the purely technical into management, into executive fields and even into public life.

Let us for a moment go back to the data I gave you indicating the present occupations of some of the graduates about whom I have made inquiries—I presume these figures can in the main be said to represent the experiences of the majority of School graduates after they have settled down into more or less permanent employment or after they have arrived, by trial and error, at their ultimate business interest, if not the ultimate place of prominence which they will attain in life, because those with whom I deal are all young men, having graduated only some fifteen years ago at the most.

Of the two classes in mining, 68 per cent. are now engaged directly in mining, 8 per cent in sales engineering (mining equipment), 4 per cent in teaching (not in mining, I believe), and the balance, 20 per cent, in occupations not at all even allied to their technical training.

It might further interest you to know that of these 25 men, sixteen are employed in Ontario, six in Canada outside of Ontario, one in the United States, one in South America and one in South Africa.

If we look at the figures available for the class of 1923—quite young chaps, only 13 years graduated—we find:

62% are now engaged in occupations directly in line with their educational courses;

11% are in allied occupations, while

27% occupy positions not at all allied; in fact some seem to have gone back to where they started from. I refer to the two farmers.

A quick and casual summarizing of the above figures might be said to indicate that some 20 per cent of the educative efforts of Professor Haultain and his staff in Mining Engineering had been wasted or, referring to the class of 1923, that 27 per cent of those graduating should never have attended the School classes. However, before we come to any decision, let us look a little farther into our subject and the results before us.

Who do you think should be better able to foresee the trend of industry than the technically trained man: in other words, the man who has been taught to apply his scientific education and later his practical training to the needs of that industry? And cannot you

see with me that if you are content to stay within your own shell of scientific occupation you will never see outside of that shell and so will not be able to avoid the pitfalls into which the greedy controllers of your industry at large and the politicians may roll both you and your shell ? I say, therefore, that no matter what branch of engineering you follow, make up your mind that you will give at least some attention to the aspects of your business and of the country's business, which is also yours, to insure that your viewpoint is not narrowed and that in protection to yourself and to your work you are informed as to the intentions and aims of others.

I have shown you that a substantial proportion of all School graduates permanently leave engineering as a vocation. On the other hand, of those engaged in engineering pursuits a number (and I hope a large number) are concerned with the managerial and executive sides of the business. I have also indicated that of the engineer is to make engineering safe for engineers and of benefit to the community at large, he must be prepared to give attention to affairs of general or public interest. That I think we are all agree on. However, the next step in the course of a logical procedure is that he must also be prepared to, first, give voice to his practical viewpoint, and then must be prepared to offer leadership. If we follow through, therefore, the line of duty as indicated, it is questionable just where we cease to be an engineer; or, in other words, just where we can be looked upon as an ordinary citizen with engineering training; in other words, if John Galbraith was right in telling us on graduating that we had only been shown how by study and work we might become engineers, doesn't it follow that in the broader viewpoint of becoming useful citizens we pass through the engineer's stage, or the doctor's stage, or the lawyer's stage, into executive positions or public life?

If, for example, you look over the political field to-day, you will find that in politics the lawyers are about the only professional men who are largely represented in parliament. Perhaps the doctors are the next most prominent, with the engineers hardly even heard of. I have heard that situation discussed and it has been explained that it is a natural situation because, first, the lawyers in any event are interested in law making, and, second, both the lawyers and the doctors have opportunities for public contacts and hence for publicity and public support at elections that are denied engineers. Perhaps the lawyers are interested in making laws, but do you realize they make laws that govern you, and do you realize they make laws that deal with your liberties and the liberties of industry.

Their views are subject to influence by lobbyists and by opportunists, and perhaps on occasion they seek technical advice on matters with which they are not personally familiar, but do you not think it would be much preferable for the practically trained man to be personally represented and to discuss those matters on which he is informed on an equal footing rather than as a paid employee. A discussion in which you are permitted to emphasize your points and to talk back to the doubters or uninformed is so much more effective than the presentation of a written or even verbal report for which you may or may not be paid but on which, once you have said your say, the others do the operating and not you, who have produced it. May I also just add that engineers should develop a second vocabulary—one the cold language of reports and one that can be understood both ways by the ordinary citizen.

I would like to add a word as to how I think this problem of public interest should be tackled.

First of all, you must create and maintain means of getting together with other engineers. There are plenty of societies and organizations for this purpose, and my statement that you must create means for the purpose does not visualize the forming of new societies. Rather, I would say *don't* become joiners but *do* carefully select the organization you intend to join and then *don't* stay a member only on the rolls but *do* attend the meetings; and, if you don't find opportunities for discussion of problems of public interest, create them. As to the organization you should belong to, I don't intend to advise you beyond saying that to my mind one of the most important is the Alumni Association of your own School. Don't lose touch with your fellow graduates, who at least start out in life with the same ambitions.

For those who will shortly find themselves in a vocation not even allied to the description of your educational course—be it Civil, Mechanical, Mining or any other course in Applied Science—I venture to say that whether you find yourself making soap, underwear or foodstuffs, running a dairy or selling insurance, you will never regret the practical viewpoint you have acquired at the School. I would add that if it were left to me to direct a young man into a course of training that would best equip him for general business life, including management and executive preparation, I could not name a more suitable course than that of Applied Science. May I point out here that of 121 graduates of the year 1923 whose present positions are known, 34, or nearly 30 per cent, have attained executive positions only 13 years after graduation and that nearly one-

third of these have arrived at these positions in other ways than through employment in technical work. I have simply selected the years 1921-22 and 1923 for demonstration purposes because the figures were readily available.

There is, however, one attribute lacking with most engineers that is a serious loss. I refer to their inability to express their views either vocally or in the written word in such a manner as to be readily understood by the public at large. Perhaps even this is being complimentary to a large number as I have personally seen technical reports that are so stilted in their phraseology as to be pitiful. As orators engineers are usually something less than 1 per cent efficient.

Does this indicate that our training is such as to make us afraid to make statements which might be questioned as to fact, or does it mean that our training in English and the classics has been too foreshortened in the interest of subjects that are supposed to really matter in the industrial field? I am inclined to think it may be a combination of both.

Perhaps some attention should be given to this shortage in the curriculum—perhaps it is something for you students to pay some attention to in your Engineering Society. However, it should be taken care of—I point out the need and leave the remedy in your hands.

I am afraid I have given you very little to-day that will improve your scientific education; I have given you very little that will help you to get a job, but I do hope I have been able to place before you one aspect of your future interests and obligations such as to make you give thought to the necessity for viewpoint and action on your part more in line with the affairs of the world around you.

In closing I would leave with you the suggestion that you remember the School—remember the University, and at all times remember the position you should fill in life.

Engineering Education

BY J. W. BAIN
Professor of Chemical Engineering

Most of the men and women of to-day who have passed the age of fifty can remember with a thrill their first acquaintance with a newly invented instrument or apparatus such as a telephone, an electric street car, an automobile, an aeroplane, a moving picture, or a radio, not to mention such less known things as an X-ray

machine or an infra-red photograph. The generation just referred to, have seen domestic lighting by the flat flame burner replaced by the Auer mantle and the acetylene flame, both of which have disappeared so completely in the cities that many children are quite ignorant of their possible use as mediums of illumination. Welding and cutting metals with the oxy-acetylene torch, the use of mercury and sodium incandescent lamps and the beautiful reds and blues of our neon signs are still in their youth, and one is constantly hearing of new advances which tend to depreciate the values of what we now consider to be firmly established.

If we leave the broader fields of general interest to that mythical personage—the man in the street—and enter the special domains of the various branches of science, the survey of modern progress is still more impressive. Only after a considerable acquaintance can one appreciate the rapid progress in any particular direction, but on all sides there is the same concensus of opinion as to the rapidity with which advances are being made.

There is no doubt that such ideas have occurred to all of us, and for each there will be a selected list of improvements, inventions, discoveries and explorations which make their appeal because of those curious tastes and bents, for which we can offer so little explanation, and by which the currents of our lives are so often settled.

The reason for the recital of the names of some of these modern genii is this. The engineering education of forty years ago dealt very properly with the fundamentals of physics and chemistry, and superimposed instruction on steam engines, arc lamps, crucible steel manufacture, the production of sodium carbonate by the LeBlanc process, and many other topics. The training was good and the graduates carried on the noblest traditions of engineering, but what great changes have taken place since the first Niagara power plant and the Quebec bridge were built. The engineer of to-morrow must have more than a bowing acquaintance with subjects which the previous generation knew little or nothing about, what was mere abstract theory a few years ago is now the necessary equipment for the well-trained man.

There can be no argument as to the necessity for thorough training in fundamentals—no structure can be satisfactory without adequate foundations. The increasing demand of modern theories is for improved teaching in mathematics, physics and chemistry, which is being partly met, it is true, by better instruction in the pre-university schools.

With a call on one hand for more advanced instruction in the fundamental subjects, and on the other for some treatment in the higher years of the newer developments and theories, it is plain that the limit of possible instruction will soon be reached—if it has not already been reached.

Looking towards the future, it appears therefore, to be inevitable that the courses in engineering should be lengthened to five years, and were this not a grave question of student finance, the faculty might feel encouraged to discuss it in earnest. May I say at this point that these ideas are merely my own and whether they are shared by my colleagues or not, I do not know; they must not, however, be taken as representing the mind of the faculty in any way whatever.

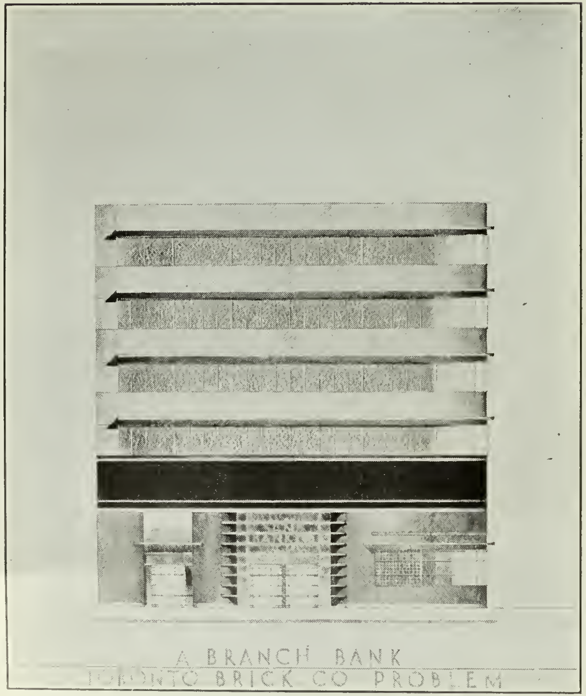
The strong desire to spare the student the additional burden of a fifth year, calling not only for financial sacrifice but also for valuable time, has so far prevented any serious discussion among engineering colleges, with one or two exceptions, but if one faces deliberately the growing demands on the engineer, it appears to me that the lengthening of the course can not be postponed for many more years. How and when the change may come I cannot venture to prophesy, but come it will, beyond question, and we may as well prepare our minds for the new condition.

When living in France eighteen months ago, I paid some visits to a provincial French University, and polytechnical school of very good reputation, I was particularly struck with the lack of interest in their students which was displayed by the teaching staff; the former were treated as if they were wooden statues, and they revenged themselves by spending much of their time in cafes. A very considerable proportion considered it to be the normal course of events to spend two or even three years in attempting to pass into the next higher year, and no one seemed to pay the slightest attention to that unfortunate class which only needs a little extra push to climb the grade.

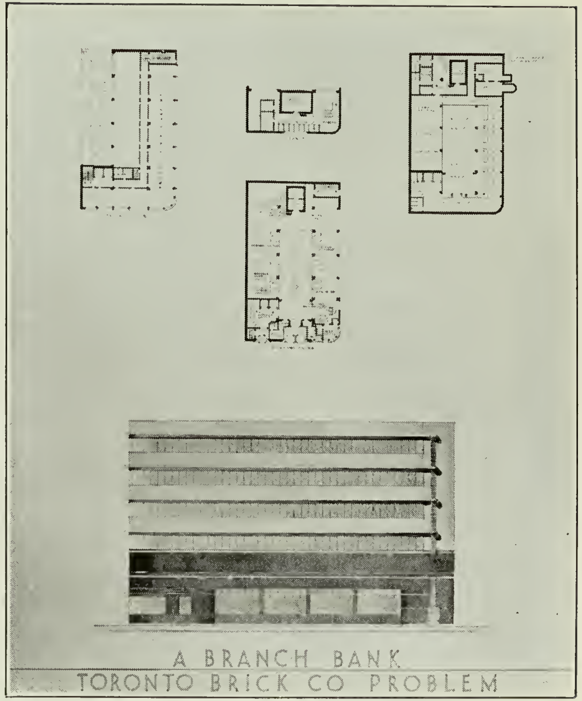
It seemed to a Canadian to be a serious waste of good raw material, but one must realize that in an old and crowded civilization many more fall by the wayside than in our happier land of many opportunities. Let us at least hope that while we may be forced to lengthen our courses in the coming years, we may be able to steer clear of that school of indifference which could so effectually check the progress of many Canadian crafts driven by ambition and guided by friendly advice from older heads.

SCHOOL OF ARCHITECTURE

FOURTH YEAR DESIGN



Street Elevation



Plans and Side Elevation

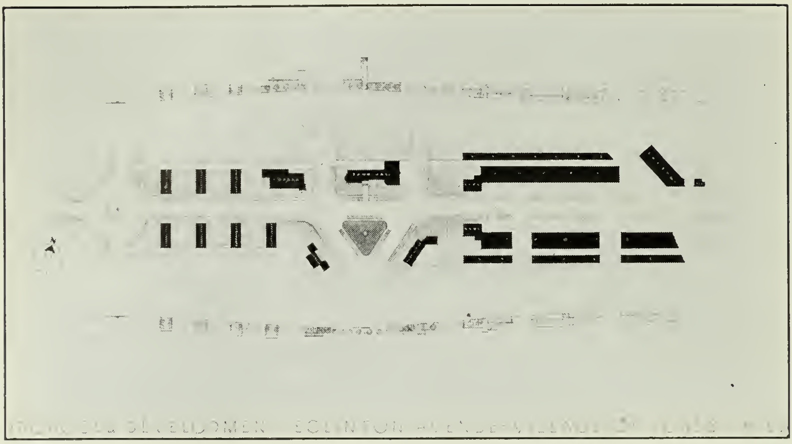
BANK AND OFFICE BUILDING

Designed by K. J. Duckworth

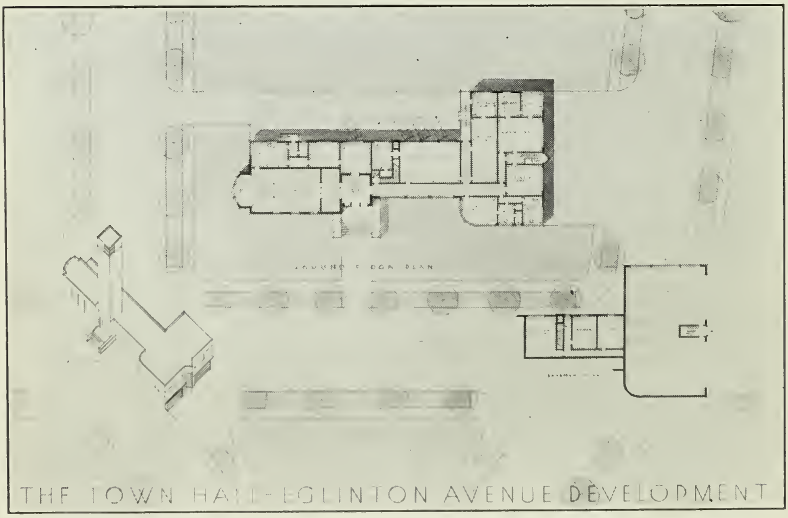
SCHOOL OF ARCHITECTURE

FIFTH YEAR DESIGN

Replanning of Eglinton Avenue between Bathurst Street and Spadina Road



Plan showing suggested location of Forest Hill Village Administration Buildings, shopping area, and apartment houses.

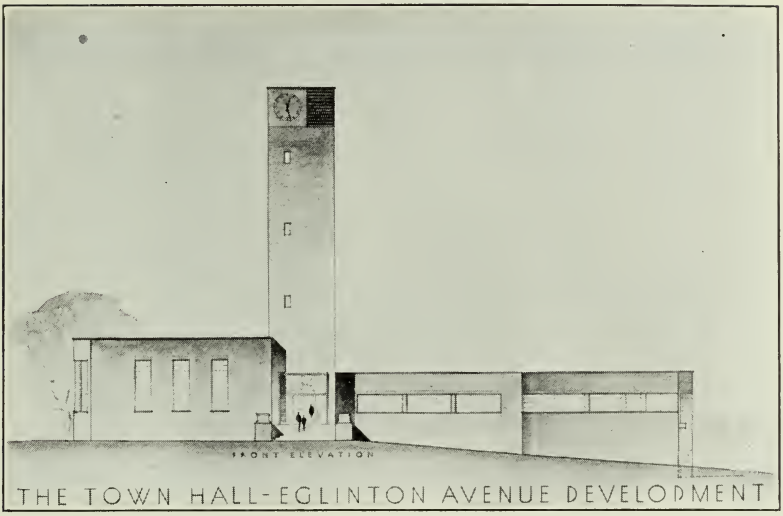


Plan

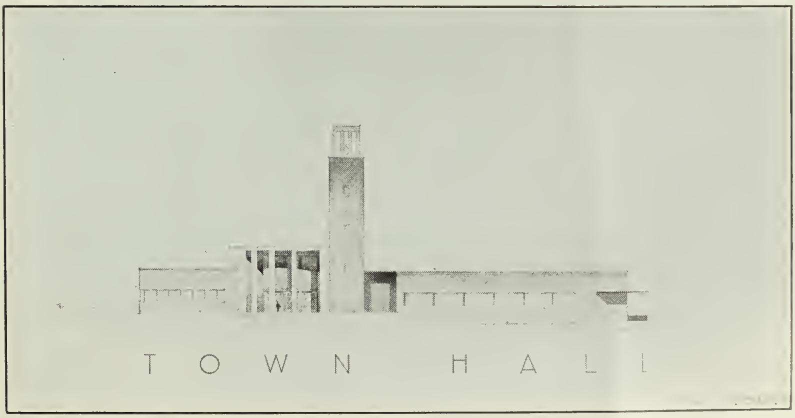
Design by G. L. Seltzer

SCHOOL OF ARCHITECTURE

FIFTH YEAR DESIGN



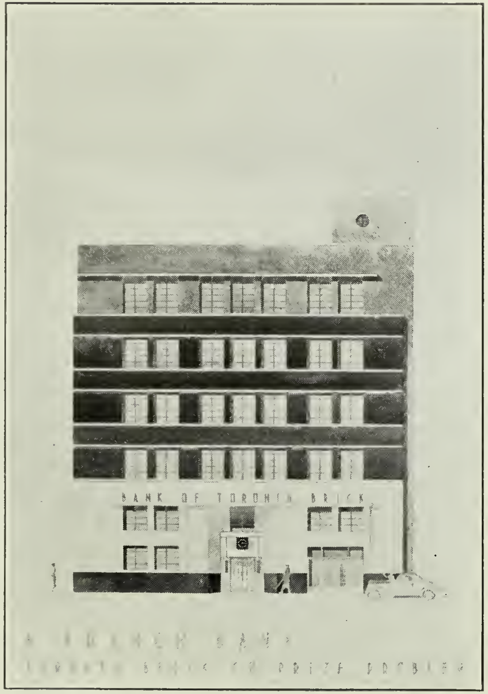
Elevation of G. K. Seltzer's Town Hall



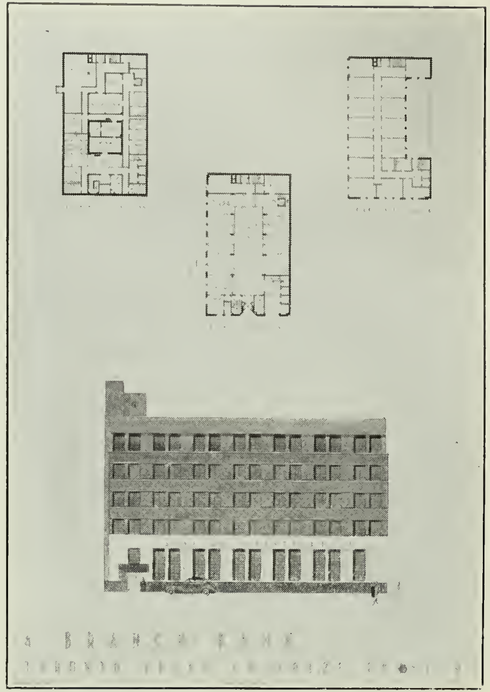
Elevation of Town Hall by F. N. Smith

SCHOOL OF ARCHITECTURE

FOURTH YEAR DESIGN



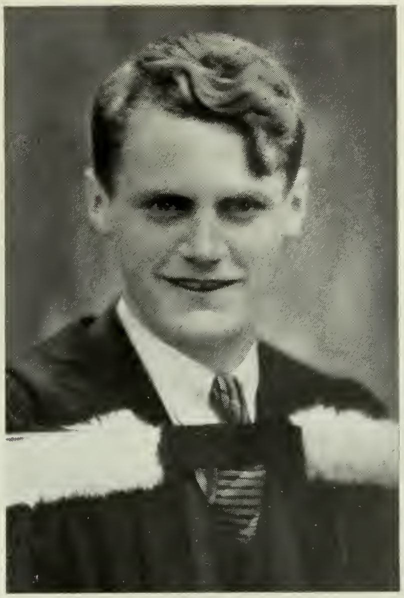
Street Elevation



Plans and Side Elevation

BANK AND OFFICE BUILDING

Designed by A. H. Taylor



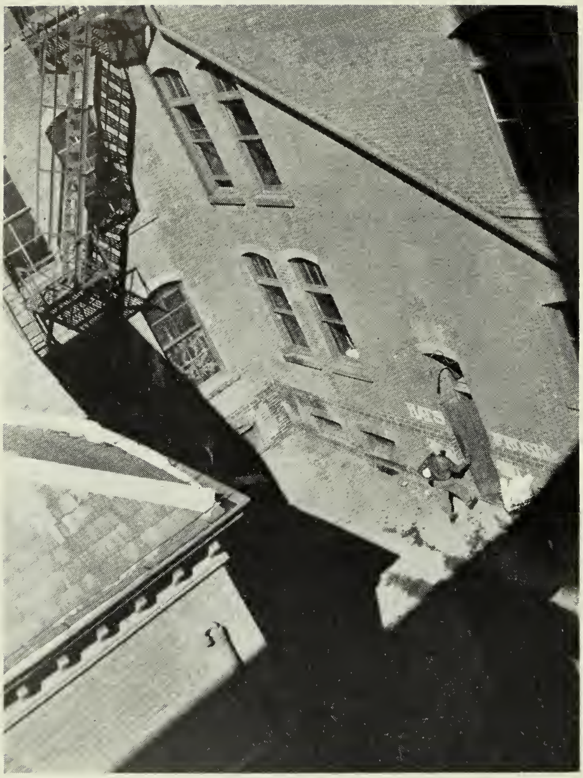
George W. Phene, fourth year student in Chemical Engineering died on October the twenty-sixth, 1936, as the result of injuries received when playing rugby on the "School" Mulock Cup team.

Although only twenty-three years old, he had an experience behind him that comes to few in a lifetime. He was born in Brooklyn, N.Y., and spent the first three years of his life in Hankow, China, then returned to New York, having circled the globe before his fourth birthday. In 1918 he went to France and was in Paris when it was under shell-fire.

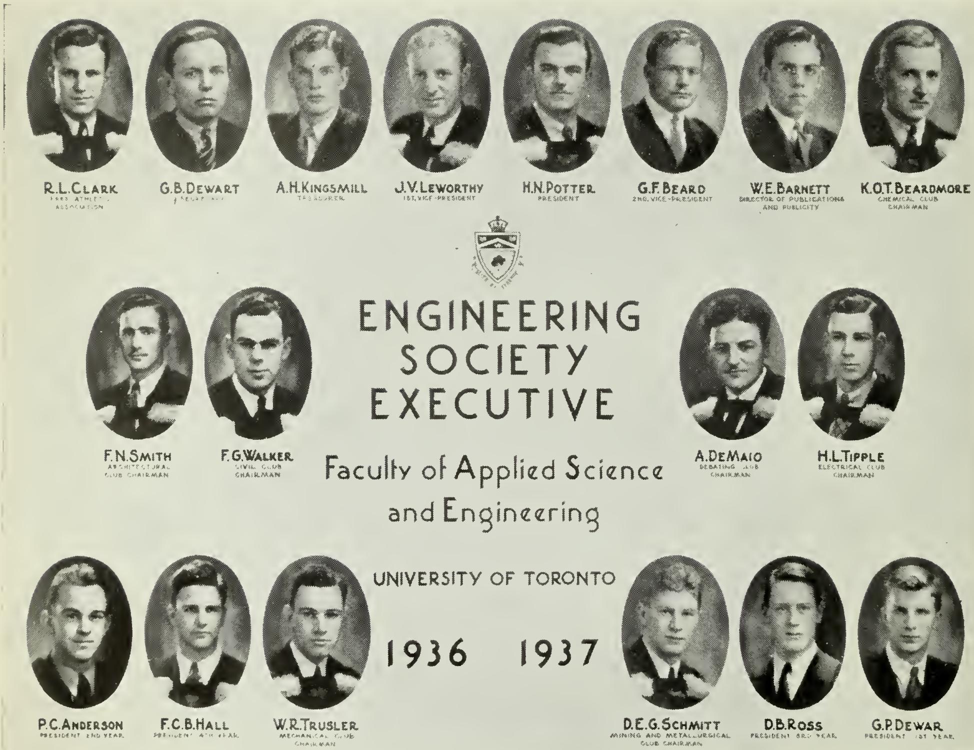
Having been buffeted between various national viewpoints, he was still groping in search of an ideal which would satisfy his conscience, fearless and generous, intelligent and true.

At St. Michaels' College and later at the University, in the sphere of athletics, he was an exceptional example of one who always fought hard and clean for his team, for the honour of his school, and above all else for the sake of the game itself. In all forms of sport, rugby, hockey, swimming, paddling, he was an inspiration to his team-mates, whether in victory or defeat. His success is attested by the many medals and prizes he won as a member of the Parkdale Canoe Club.

No more worthy tribute can be paid to a man of George Phene's athletic ability than that he played the game for the game's sake.



YEAR BOOK


R.L.Clark
G.B.Dewart
A.H.Kingsmill
J.V.Leworthy
1st. Vice-President
H.N.Potter
President
G.F.Beard
2nd. Vice-President
W.E.Barnett
Director of Publications and Publicity
K.O.T.Beardmore
Chemical Club Chairman
ENGINEERING SOCIETY EXECUTIVE
F.N.Smith
Architectural Club Chairman
F.G.Walker
Civil Club Chairman
A.DeMaio
Debating Club Chairman
H.L.Tipple
Electrical Club Chairman
Faculty of Applied Science and Engineering
UNIVERSITY OF TORONTO
1936 1937
P.C.Anderson
President 2nd Year
F.C.B.Hall
President 4th Year
W.R.Trusler
Mechanical Club Chairman
D.E.G.Schmitt
Mining and Metallurgical Club Chairman
D.B.Ross
President 3rd Year
G.P.Dewar
President 1st Year

Gone With April Zephyrs

BY HERMAN XENOPHON MACWHIRDLE GIRDLE

Editor's note—The following is a review of H. X. M.'s famous contemporary novel done for us, at no extra charge, and with no obligation to buy, if you'll only let me demonstrate, madam, by that great cricket (Assistant Editor's note: delete and add "critique"), William Witherspoone Hootnanny.

I can assure you that Herman's novel was based on truth. In fact, the only criticism to be offered on the whole bally business was his puerile effort to cloud a good issue with 79 or 80 beers. (Herman was a Schoolman and, since the depression has passed, has reverted to the old order of 80 rather than 40 beers.)

In his book, Xenophon describes several very interesting characters, by means of which he attempts to prove to an eager world that he who has buttered his bread must lie in it, or two birds in the hand are twice as bad as one in the proper place, or something on that order. (It's been so long since I read the book, how can I be expected . . . ?) Anyway, his setting is S.P.S. in the years of our monkey business, 1933-37. His hero is H. MacNeville Potter-Potter, a direct descendant from a hirsute tribe of apes and the last of a long line. He is the black sheep of a family of dirty gray ones who lived in a fire trap called (not usually) the Mining Building. Potter-Potter's most interesting lines come in Chapter IV, when he is heard to mutter through his foamy beard "steady panic throughout the year makes final exams come too damn slowly, so why worry?"

The heroine is Lady Margaret Sheppard sometimes referred to as the "Whistling Duchess" (not to be confused with Whistler's "Old Woman"). She brightens the story up considerably. However, Herman doesn't play on her character enough. He could have done better by describing her as a Beer Baroness or a Tymologist. He sure messes up her romantic life, though. Somebody is always in love with her. Even flowers. He describes one poinsettia—but that's of no particular interest.

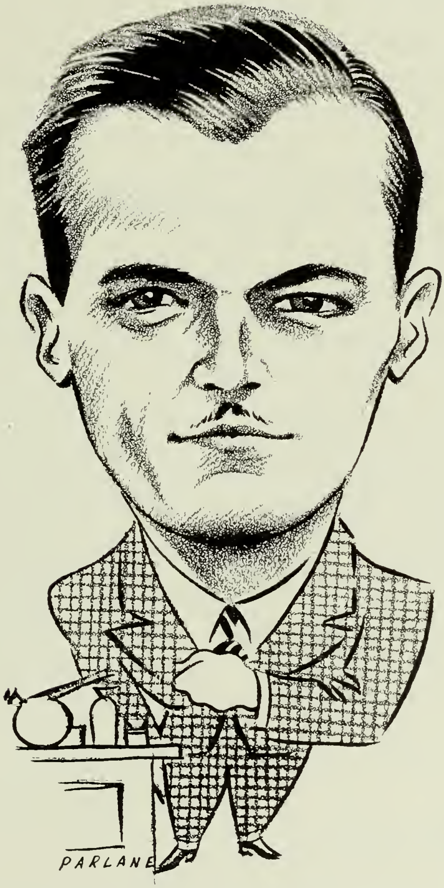
The villain of the story is a guy named Smokehouse Bronskill—a great, tall fellow weighing about 350 pounds with a hook nose and a great mop of hair. He makes his entrance early in Chapter I bellowing "Stand well back, for it's not for beer that we come to College". He's always messing around somewhere in the story with his

aide-de-camp, Droopy-Drawers Macdougall. At one point in the last chapter, they try to deceive the public by appearing as a dance team, with Smokehouse's hair neatly marcelled.

In rapid succession in the first chapter, and elsewhere, Xenophon introduces Clay-boy Hall who later turns out to be a fine wife for somebody, and stuff, and Jake (F. N.) Smith, who once shaved his mustache off for art's sake (or was her name Art?) and that great inventor O, my Arison-end (Celanese to you) whose most noteworthy invention is briefly mentioned in Chapter III (namely, a seive without any holes in it, for people who aren't very much interested in sifting anything) to say nothing (but we have to) of Swivel-Jaw Longbeard Northover, a citizen of the first 40 beers (afterwards a firm believer in 40 dears) who once won a beard-growing contest by refusing to pluck his eyebrows (or pick his teeth in public). There is also a touch of pathos in the story. In every chapter we meet the same character, one Calling-Newark-Air-Port Leworthy, wrestling (in code) with the temptation to go and hear President Cody's opening address. He finally succeeds, but the poor fellow nearly goes mad with it all. This fact is brought out at the end as he sings that doleful lament "There's rhythm in my nursery rhymes—or the Ghost ghost to town." By golly. That about closes the book. Oh, yes, I did forget to mention that in the last chapter, Lord Potter-Potter forms a Sunday School Class. And herein lies some of Xenophon's finest work. The Devil was a sissy when compared with the boys he tells us of. Little Rossie Clark was a good lad until somebody told him there wasn't any Santa Claus. That broke his heart and he formed a gang. He picked up Wild Willy Salter (whom somebody deceived by pouring him water instead of gin) and Butch Walker and Dutch Schmitt (whom everyone thought was nice till they saw the way he swiped paper from the Eng. Soc.—two sheets, I think) and Blackie Church (who used to sit and watch goldfish starve over a brimming bowl of suds and a hand of bridge for exercise). There were others too, Honest. Even a fellow called Stilts McBane, a little rapscallion.

But the story ends nicely, I think. Nobody gets hurt much except Jack Shaw and everybody dies digging ditches. Ah, but there, I'm anticipating Herman's sequel, called "Where do ya worka John?" or "What, more bread and not a drop of liquor in the house?"

Who's Who in the School



H. MacNEVILLE POTTER-POTTER

ENGINEERING SOCIETY ELECTIONS, 1937

RESULTS

ENGINEERING SOCIETY EXECUTIVE

President	G. F. Beard
First Vice-President	J. R. Millar
Second Vice-President	P. C. Anderson
Treasurer	J. H. Rogers
Secretary	G. P. Dewar

ATHLETIC ASSOCIATION EXECUTIVE

President	J. D. Fox
Vice-President	K. M. McQuarrie
Secretary-Treasurer	R. N. Galway

CLUB CHAIRMEN

Debates	R. E. Bates
Architectural	W. H. Birmingham
Civil	W. M. Hogg
Chemical	G. E. Giddings
Electrical	E. L. Doddington
Mechanical	I. W. Smith
M. & M.	A. H. Kingsmill
Engineering Physics	J. R. Leslie

3T7 PERMANENT EXECUTIVE

President	J. V. Leworthy
Vice-Presidents	W. H. Arison
	F. C. B. Hall
Secretary-Treasurer	H. N. Potter
Councillors	F. G. Walker (Civil)
	T. M. Childerhose (Mining)
	W. A. Salter (Architecture)
	C. G. Lumbers (Mechanical)
	K. O. T. Beardmore (Chemical)
	H. L. Tipple (Electrical)
Bronze "S"	R. G. Alison

3T8, FOURTH YEAR

President	J. C. Langford
Vice-President	J. L. Hemphill
Secretary-Treasurer	W. H. McPherson
Athletic Representative	N. Hogg

3T9, THIRD YEAR

President	L. H. G. Kortright
Vice-President	A. A. McArthur
Secretary-Treasurer	E. G. Apps
Athletic Representative	G. F. Kirby

4T0, SECOND YEAR

President	G. M. Scott
Vice-President	G. B. McKendrick
Secretary-Treasurer	A. W. Wardell
Athletic Representative	W. C. Schwenger

Civil Club

The purpose of the Civil Club is twofold. It aims to produce a close friendship between the members of all years in Civil Engineering and to bring to them men of wide Engineering experience, in order that the latest developments in this field may be ascertained and discussed. Throughout the year every attempt was made to achieve this aim by promoting varied club activities.

On October 30th, the members of the second, third and fourth years paid a very valuable and interesting visit to the Port Colborne plant of the Canada Cement Company.

The first meeting of the season took the form of a dinner at Hart House followed by an extremely clear and instructive talk on Practical Bridge Construction by Mr. A. B. Crealock.

The annual Civil At-Home, the chief social event of the club, took place on January 6th, at the Boulevard Club. This dance, held in conjunction with the Mining and Metallurgical Club, supplied a high standard of entertainment for the "exam-celebrating" Civils and Miners.

The next events of this session were three very successful smokers at Hart House. At the first, on January 27th, Dr. A. E. Berry, Head of the Sanitary Division of the Department of Health of Ontario, spoke on the various aspects of Sanitary Engineering in Ontario, illustrating his lecture with well-chosen slides. Three weeks later, Professor T. R. Loudon dealt with the timely subject of Aviation, also providing descriptive slides. In the latter part of February three of the fourth year civils followed the example of the previous year and gave talks on their theses.

The Club's activities were topped off towards the middle of March with a luncheon meeting with A. E. (Doc) Gallie, S.P.S. lion-hunter, as the guest speaker.

Throughout the term, fortnightly bowling nights were well attended by all years. This type of informal entertainment helped materially to better acquaint the members with one another, and to round out the year's activities.

The executive wishes to take this opportunity to express sincere appreciation to every member of the Club who contributed to the success of the various functions, and especially to the professors who have co-operated so willingly.

F. G. Walker,
Chairman.

PROF. T. R. LOUDON
HON. VICE-CHAIRMAN

PROF. C. R. YOUNG
HON. CHAIRMAN

F. G. WALKER
CHAIRMAN

PROF. W. M. TREADGOLD
HON. VICE-CHAIRMAN

W. M. HOGG
VICE-CHAIRMAN

CIVIL CLUB EXECUTIVE

Faculty of Applied Science and Engineering

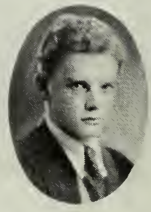
UNIVERSITY OF TORONTO

1936 1937

J. D. NEAR
SEC.-TREAS.

D. G. WILLMOT
4TH YEAR REP

G. G. BIELBY
3RD YEAR REP



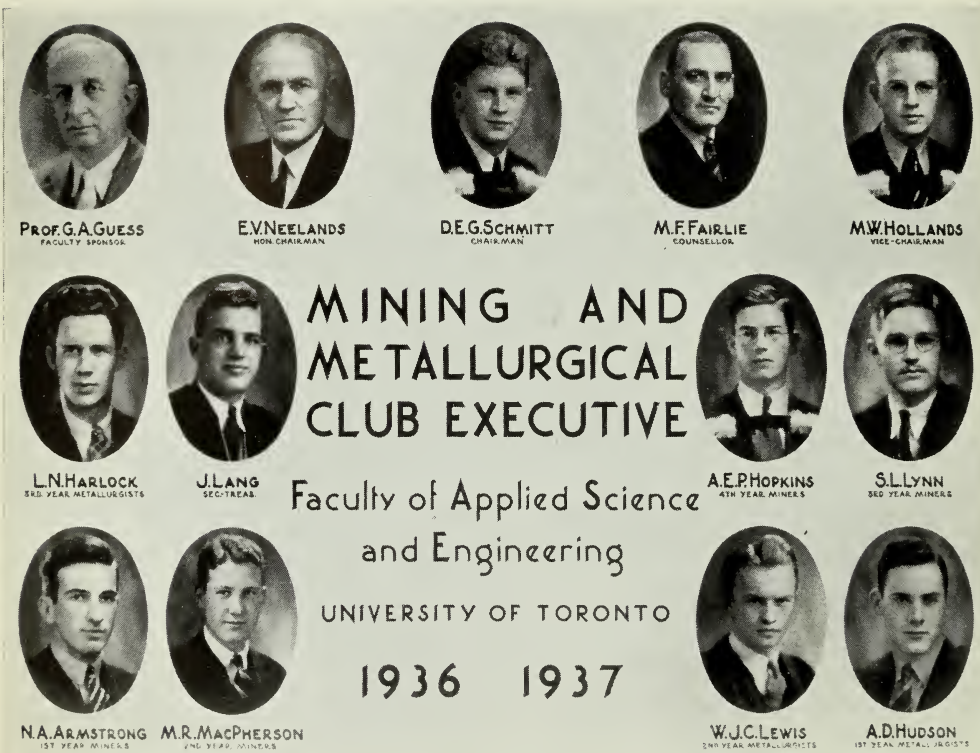
J. H. ROGERS
2ND YEAR REP

H. L. FOSTER
1ST YEAR REP.

FOURTH YEAR CIVILS—1937

Back Row: D. G. Willmot, G. L. Bodwell, H. B. Ashenhurst, N. M. Kelly, S. D. Foote, D. W. Finlayson, R. L. Clark, J. M. A. Crowe, R. C. A. Pittis.

Front Row: A. B. C. Northover, Prof. W. J. Smither, Prof. C. R. Young, F. G. Walker, Prof. W. M. Treadgold, Prof. T. R. Loudon, H. J. P. Morgan.


PROF. G. A. GUESS
FACULTY SPONSOR
E. V. NEELANDS
HON. CHAIRMAN
D. E. G. SCHMITT
CHAIRMAN
M. F. FAIRLIE
COUNSELLOR
M. W. HOLLANDS
VICE-CHAIRMAN
MINING AND METALLURGICAL CLUB EXECUTIVE
Faculty of Applied Science and Engineering
UNIVERSITY OF TORONTO
1936 1937
L. N. HARLOCK
3RD. YEAR METALLURGISTS
J. LANG
SEC.-TREAS.
A. E. P. HOPKINS
4TH YEAR MINERS
S. L. LYNN
3RD YEAR MINERS
N. A. ARMSTRONG
1ST YEAR MINERS
M. R. MACPHERSON
2ND YEAR MINERS
W. J. C. LEWIS
2ND YEAR METALLURGISTS
A. D. HUDSON
1ST YEAR METALLURGISTS

Mining and Metallurgical Club

Though departing from the customary reviewal of the year gone by, it still can be said that our activities during the term 1936-37 can be favourably compared with those of previous years, or with those of any of our contemporary federated clubs.

The type and character of the activities has been essentially the same as in past years. It should be remembered that the present programme is one which has grown and developed with the club, having been regularly adopted and readopted year after year, by succeeding executive committees, only after due deliberation and the consideration of many alternatives. Thus, innovations and changes in procedure have been accepted not without much serious thought upon the matter. Probably one of the major and most successful departures this year has been that of having, instead of the customary entertainment provided by the freshmen, a speaker at the opening fall smoker. Although it has perhaps meant the breaking of a tradition, we have had to recognize a changed condition and the smoker this year with Mr. Richard Pearce, President of the *Northern Miner*, as the guest speaker, was one of the most interesting and instructive meetings of the year.

The rapid increase in the membership of the Club has been amazing, and it is some indication of the growing interest and the recognition of possibilities in the industry which we hope to enter. During the last four years, our Club has grown from one of the smallest, to be at present the largest of the federated clubs. However, we take no pride in numbers, but rather in activity and achievement. Our objectives have never been lost sight of, and we have endeavoured to gain a self-sought and increasing knowledge of things pertaining to mining and metallurgy, to maintain a spirit of good-fellowship amongst our members, to sponsor an association with men of the industry and to instill a pride in the profession which we have chosen.

Our Club, known in the very early days as the Mucker's Club, has been identified as the Mining and Metallurgical Club for the last twenty-two years. The men who planned and originated this Club did so not only for the purpose of their own benefit and enjoyment, but with the same idea in mind as the man who plants an orchard with apple seeds, hoping that his children or grandchildren may enjoy the fruit. They visioned the benefits which we their successors might derive from its organization. Just as we have an

advantage of twenty-two years of accomplishment in scientific research and engineering technique over these charter members, so we have the advantage of membership and participation in a Club which has long since passed the embryo stage and which has been proven by its ability to stand up under the strain of circumstances for over twenty-two years. It is indeed a privilege to begin as a freshman, a participation over a period of four undergraduate years in the activities of a Club which has both proved its mettle and established itself as a leader.

If we are to continue this leadership and retain our present position of respect it is imperative that every member consider it his duty to lend his support and expend every effort in the furthering of our objectives. We must accept rather seriously our four-year term of responsibility for the Club's success. Our objectives must be furthered at the expense, if necessary, of our social functions, enjoyable as they may be. The position has been won and it should be a simple task to maintain it.

The current success of the Club's activities has been largely due to our previously recognized ability to select the prominent and outstanding men of the industry as our honorary chairmen. This year our associations with Mr. E. V. Neelands, consulting engineer of Ventures Limited, as our honorary chairman, and Mr. M. F. Fairlie, consulting engineer of Anglo-Huronian Limited, as our counsellor, not only have lent prestige to our society but have given us much pleasure and have proved an inspiration to the executive. The men of the industry and the practicing profession have, during the past year, indicated their growing interest in our Club as a student organization by their attendance at our meetings, and their willingness to co-operate. It is these contacts with the industry that place us in our present enviable position amongst the federated clubs and we are indebted to these men for their efforts in our behalf.

To all those whose enthusiasm and co-operation have made for the successful completion of another year in the history of our Club, the downtown men, the staff and the students, we express our appreciation. May next year's activities under the direction of your new executive again bring you a sense of achievement and a feeling that you too have contributed toward the building.

D. E. G. Schmitt,
Chairman.

FOURTH YEAR MINERS AND METALLURGISTS—1937

Front Row: Prof. R. J. Montgomery, Prof. F. C. Dyer, Prof. J. E. Toomer, Prof. G. A. Guess, Miss J. B. Bradshaw, Prof. H. E. T. Haultain. Prof. J. T. King, Mr. S. E. Wolfe.

Second Row: T. W. Verity, J. C. Martin, J. D. Christian. T. M. Childerhose, W. C. Isbister, T. A. Frankish, W. D. Jamieson, W. H. Smith, Mr. S. A. J. Hopper, D. E. G. Schmitt.

Third Row: M. R. C. Mitchell, F. G. Thompson, M. W. Hollands, J. B. Graham, M. D. Knechtel, P. E. Cavanagh, A. Frumkin, W. A. Jolly, A. E. P. Hopkins, Mr. L. F. Gauvreau.

Back Row: G. W. Walkey, A. D. Gillespie, G. R. Bruce.

FOURTH YEAR MECHANICALS—1937

Front Row: A. DeMaio, W. R. Trusler, Prof. W. G. McIntosh, Prof. E. A. Allcut, Prof. R. W. Angus, Prof. R. Taylor, Mr. R. C. Wiren, B. Chernofsky.

Second Row: I. M. Hamer, C. G. Lumbers, J. H. Leckenby, D. R. V. Malcolm, G. W. Wurts, W. A. Devereaux, P. K. Lindsey, J. W. Fry, D. M. Henry.

Back Row: W. B. Woods, G. Gung, F. W. McEwen, J. A. Burgess, M. F. Carriere, R. G. Alison, A. S. Foreman, C. E. Beynon.

Mechanical Club

The school year, now drawing rapidly to a close, has been a memorable one indeed in the annals of the Mechanical Club. To begin with, we were most fortunate in obtaining as our Honorary Chairman, Mr. W. A. Osborne, Vice-President of Babcock-Wilcox and Goldie-McCulloch Limited. Mr. Osborne, who is a past president of our Engineering Society, has been very much interested in the welfare of the Club and his assistance was greatly appreciated by the executive.

Club activities commenced early in October with the annual trip of the Fourth-year men to the power plants at Queenston and Niagara Falls, N.Y. On the same day, the Third-year students visited the plants of the Steel Company of Canada and Westinghouse in Hamilton.

On November 3rd the first smoker was held in the Music Room at Hart House. Our Honorary Chairman, Mr. Osborne, who came from Galt to be present, was introduced to the members of the club. Our chief, Professor R. W. Angus, gave a very interesting address on "The Contribution of the Mechanical Engineer to Modern Life."

The First and Second Years had their trips early in December when they invaded the plants of the Dunlop Tire and Rubber Company and the Canada Wire and Cable Company respectively.

The fall term's activities were brought to a pleasant close by that gem of the social season, the Mechanical and Electrical Club Dance. Held this year at the Roof Garden of the Royal York, it established a new high for Club dances.

The January meeting was a Smoker in Hart House with Mr. J. H. Fox of the Minneapolis-Honeywell Company as guest speaker. Mr. Fox discussed the manufacture and industrial applications of controlling equipment.

February 17th found the fourth year men setting out for Dundas and Galt to visit the plants of John Bertram and Goldie-McCulloch on their final trip of the year. This day will long be remembered by all the lads of 3T7.

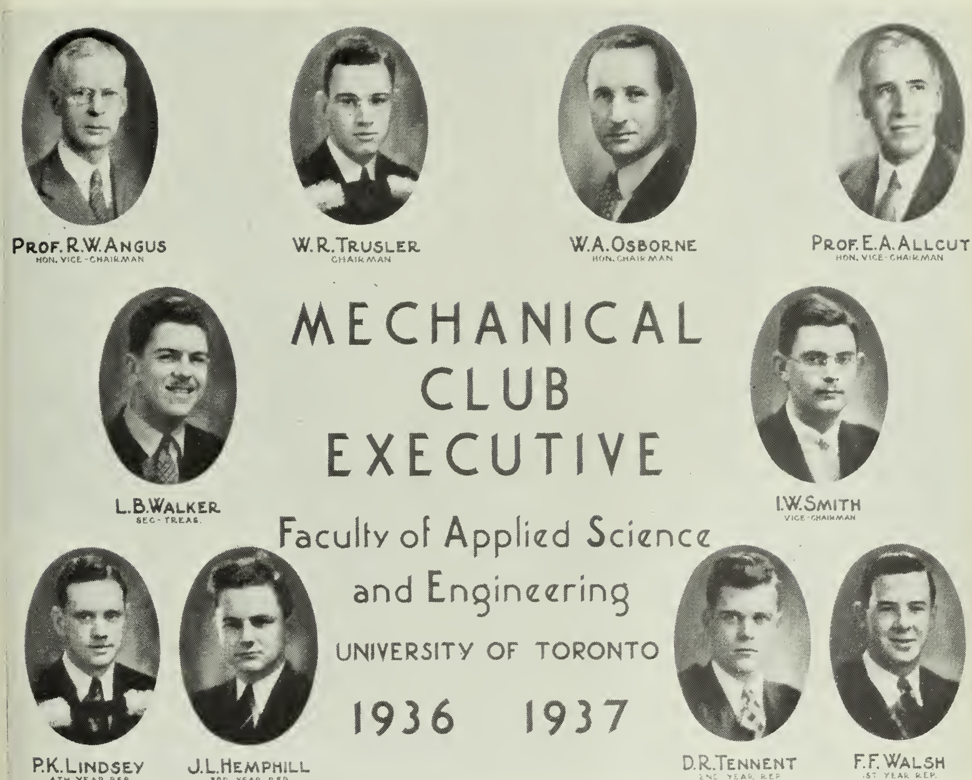
Mr. M. J. C. Lazier played a return engagement with the club this year when he again gave an address in his own inimitable way at our February smoker. This time his subject was "Stability and Steady Motion" and it provided food for much discussion after the meeting.

The final function of the year was the annual dinner which was held at the Engineers' Club on March 4th. Mr. R. E. Laidlaw, Assistant Counsel for the Central Region of the C.N.R. was our guest speaker. Taking as his subject, "The Machinery of the Law", Mr. Laidlaw went on to point out what a gigantic and yet efficient and smoothly running machine the law in Canada really is. During the evening, to the astonishment of all those assembled, with the exception of Professor Allcut, an amazing new development in the field of perpetual motion machines was announced and explained by Dr. V. M. Parrish. This new machine, as Dr. Parrish pointed out, will operate on an entirely new principle, the Pogue Cycle, which incorporates an adiabatic compression line and the astounding new diabetic expansion line. He modestly claims an efficiency of infinity plus *y*. Other features of the evening were tap and acrobatic dances, and card tricks by Mr. Carmichael.

The chairman wishes to extend thanks to all members of the club for their support during the past season. Special thanks go to the members of the executive for their co-operation and assistance and to those members who helped with the sing-songs.

Next year will find Irvine Smith at the helm as our Club Chairman. May he have a goodly crew, a following wind and a bon voyage.

W. Ralph Trusler,
Chairman.


PROF. R.W. ANGUS
HON. VICE-CHAIRMAN
W.R. TRUSLER
CHAIRMAN
W.A. OSBORNE
HON. CHAIRMAN
PROF. E.A. ALLCUT
HON. VICE-CHAIRMAN
MECHANICAL
CLUB
EXECUTIVE
L.B. WALKER
SEC-TREAS.
I.W. SMITH
VICE-CHAIRMAN
Faculty of Applied Science
and Engineering
UNIVERSITY OF TORONTO
1936 1937
P.K. LINDSEY
4TH. YEAR REP.
J.L. HEMPHILL
3RD. YEAR REP.
D.R. TENNENT
2ND YEAR REP.
F.F. WALSH
1ST YEAR REP.

The Electrical Club

The Electrical Club enjoyed a most active and successful year. The meetings were interesting, full of "School" spirit and helped toward inter-year acquaintanceships which is a primary object of the Club.

This year an Honorary Chairman was chosen for the first time from the Electrical industry—Mr. George Lawrence, President of Sangamo Limited, graduate of 1915. It was believed that this policy would improve relations between prominent men in Electrical Engineering and the students.

The elucidation of the various fields of Electrical Engineering was the main policy with regard to speakers. The fourth year options: communication, illumination, hydraulics, electrochemistry and thermodynamics were the basic topics.

The "Science of Lighting" by Mr. J. W. Bateman of the General Electric Company introduced the series. Methods of measurement and improvement of lighting were revealed.

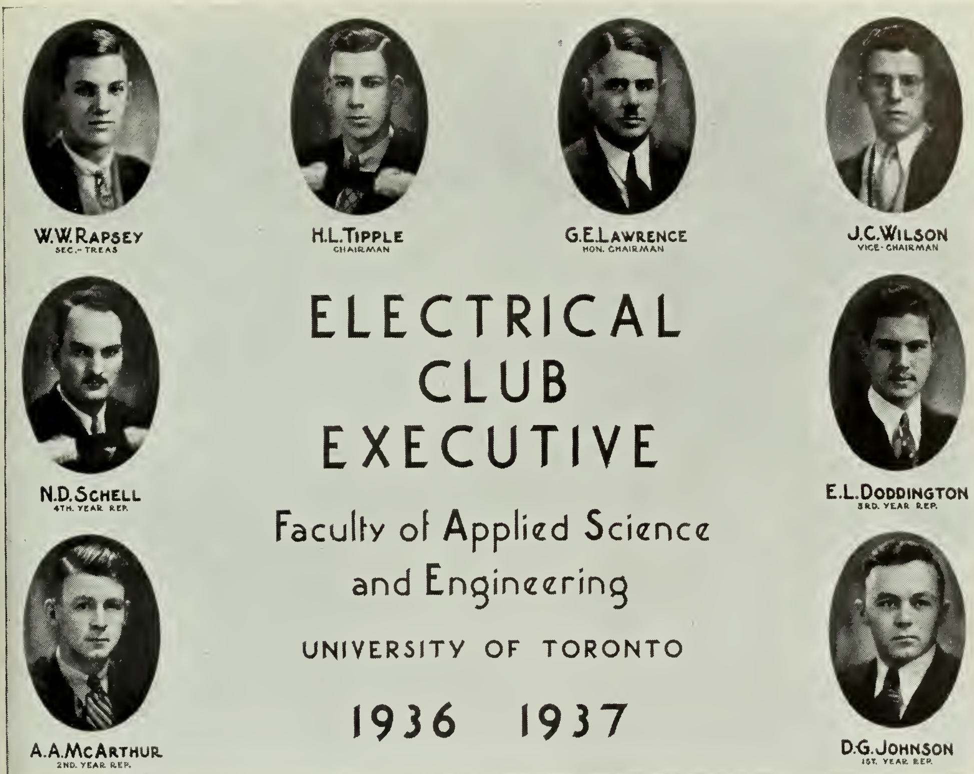
"Hydro-Electric Power Development" was very capably discussed by Mr. J. R. Montague of the Ontario Hydro Electric Power Commission. The variety of the problems and the great amount of development work to be done in Canada should make this field very popular with present undergraduates.

The spirit of co-operation produced a most enjoyable and tuneful terpsichorean interlude for the Electrical and Mechanical Clubs in the Royal York Roof Garden shortly before Christmas. Beautiful maidens, gallant engineers, soft music, dim lights and——Oh, what a night!

A tour through the Leaside Substation of the O.H.E.P.C., one of the most efficient in the world, was very interesting. Mr. Publow, the designer, accompanied the party and explained many of the features of the station. The control room with dozens of meters and a nine-circuit oscillograph, were highlights of the tour.

The kindred higher mathematical field, astronomy, provided a valuable evening at the Dunlap Observatory, where light years and millionths of an inch were discussed with amazing facility. Professor R. K. Young, the designer and second in command informed the club that astronomy awaits improved engineering before astronomers can advance.

"Europe in a Bombshell" was discussed with thrills by Wilson Woodside, a popular School graduate, now a writer and lecturer on foreign affairs.



Efficient mechanization was observed in the tour of the Central Bell Telephone Exchange. The maze of intricate equipment and activities necessary to maintain it in perfect condition were capably explained.

The term came to a grand climax at the annual dinner at the Engineers Club. Lt.-Col. Fraser Hunter, soldier, author, sportsman, and scientist addressed the club on "Civilization To-day," after which it seemed doubtful if there was any.

The employment situation in Electrical Engineering is most favourable, and we wish everyone, especially the graduates, satisfactory employment to crown their undergraduate efforts in this the Coronation year.

H. L. TIPPLE,
Chairman.

FOURTH YEAR ELECTRICAL ENGINEERING—1937

Front Row: J. W. Kerr, D. J. F. Coulson, Prof. B. de F. Bayly, Mr. R. J. Brown, Prof. H. W. Price, Prof. V. G. Smith, Prof. A. R. Zimmer, Mr. J. E. Reid, H. L. Tipple, N. D. Schell, R. A. Baker (front).

Middle Row: D. G. Macdonald, G. G. M. Eastwood, J. V. Leworthy, D. V. Cohoon, A. K. Wickson, W. J. Bagshaw, J. Everett, F. V. Pringle, J. M. Vanderleck, A. A. Wanless.

Back Row: R. Stroud, L. G. Macdougall, J. F. D. Tuke, F. R. Quance, D. A. Mitchell, R. S. G. Griffin, W. K. Dow, E. Whiteley, R. G. Anthes, V. B. Coxworth.

FOURTH YEAR CHEMICALS—1937

Left to Right:
Back Row: R. M. Powell, J. A. Hornibrook, S. Sibbald, M. Adelmann, K. Voss, A. E. Penney, A. S. Weatherburn, J. Shaw.
Sixth Row: J. Dunn, W. Phene, A. Fisher, H. Freestone, E. DeLuca, Dr. Breckenridge.
Fifth Row: H. Hartman, D. McBane, B. Bronkill, A. R. Stewart, M. Bartlett, D. F. Smith, H. D. Algie.
Fourth Row: J. Ruddell, I. K. Phillips, P. McMillin, A. B. Bull, R. B. Beckett, F. Mundy, W. A. Armstrong.
Third Row: H. N. Potter, L. W. Smith, A. B. Hart, O. C. Smith, W. H. Arison, E. O. Boddy, J. Perold, H. G. Winnett, B. Marks.
Second Row: J. Grieve, H. Kellner, E. G. D. Macpherson, Miss M. Sheppard, L. J. Pritzker, R. Podwin, J. M. Troster, B. Lewis.
Front Row: Dr. Boswell, Prof. Bain, K. O. T. Beardmore, Prof. Ardagh.

The Industrial Chemical Club

This year for the Club has been a most successful one. The smokers, while not all of a strictly chemical nature, have been most interesting and educational and generally well attended. It has been the aim of the executive to acquaint embryo chemical engineers with the problems of the business world. Not the problems in chemical plants but the problems which face a man in an executive position. If even an interest has been stirred among some of the members then the retiring executive feel well pleased.

At the first smoker of the year, Professor E. J. W. Bain gave a most interesting talk on Spain and some of the conditions existing there last year. Fortunately, Professor Bain left Spain before the revolutions broke out but showing us the different natures of the inhabitants of the different parts of Spain certainly threw a different light on existing conditions.

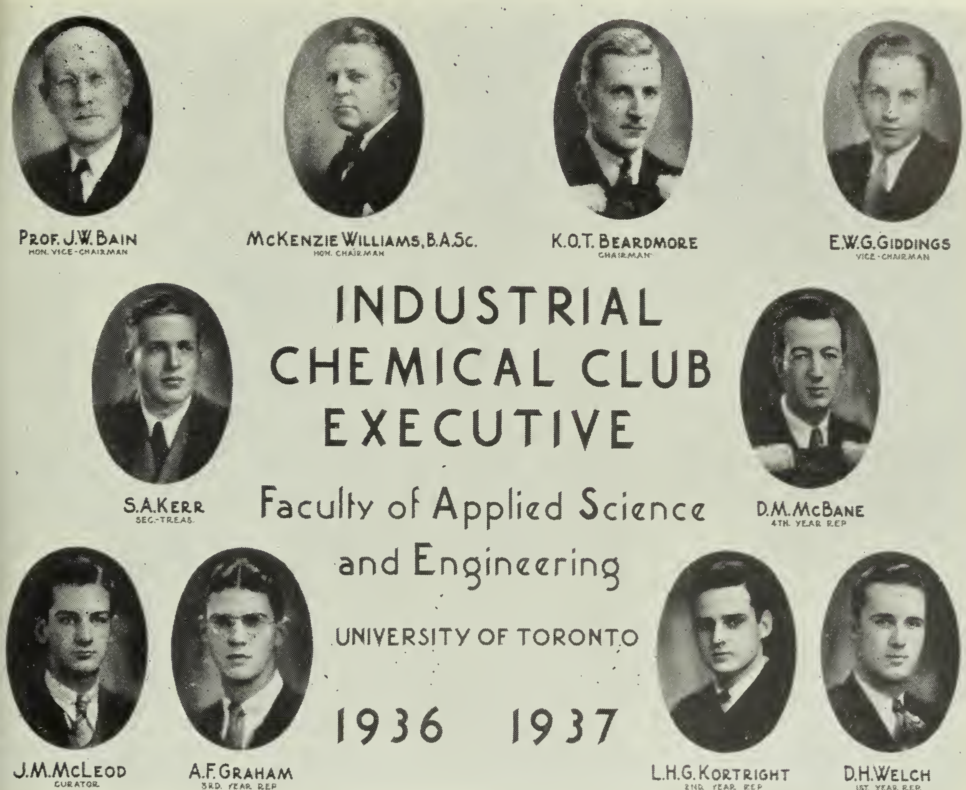
A second smoker was held at Hart House in November and here we were fortunate enough to listen to Mr. McKenzie Williams, our honorary chairman, in a most educational address on "Storm and Fair Weather Signals in Business". Mr. Williams has that fine gift of making a subject interesting as well proven by the number of questions asked after the address.

On November 13th, the customary visit was paid to Niagara peninsula and three interesting plants visited, the Canadian Industries Plant in Hamilton, the Ontario Paper, and the Beaver Board Company at Thorold. After visiting the plants the bus continued to Buffalo and several places of higher education were visited but fortunately not the local judge.

In December a dance was held at the Hotel Savarin and a most enjoyable evening was passed by all and sundry. Here the singing of Joe Perold delighted radio fans from coast to coast—(loud and long were the "encores").

A smoker was held in January at which we were addressed by Mr. Davidson of the Bakelite Corporation, telling us some of the great work of Dr. Bakelin. Motion pictures of the manufacture and some of the uses of Bakelite were shown, after which Mr. Campbell, chief chemist, answered many questions more or less flung at him by some of the more inquisitive members.

The final fling of the year was a dinner at the University Club, at which Willson Woodside, a graduate of the school, gave a most interesting talk on Sweden, illustrated by slides of photographs



taken by him on his travels there. The fourth year chemical orchestra held forth in great form and loud were the cheers (?)

This winds up the year's activities and the chairman would like to thank the members of the executive for their fine co-operation and work throughout the year and to wish the club every success under the new chairman, G. E. Giddings.

Knox Beardmore,
Chairman.

The Architectural Club

"Architecture is frozen music" . . . Schelling

Is this appropriate? What hours of earnest search were spent that tribute might be paid. And yet, how paradoxical the sound. Far better that we *coin* an apt quotation, and thereby catch the true spirit of our Club. Thusly . . .

And rising great, the sun did shine
On chicken-coops, and architects, and Us . . .

That is much to be preferred. It takes in the Building Trade, the Profession, and the Architectural Club, and it has that appropriate feeling about it, somewhat reminiscent of the Barnyard!

Equally all-embracing have been the activities of the Club this year. An excellent group of men and girl have helped to make them so, and it would be difficult for any club chairman to find a more co-operative and agreeable group with whom to work.

We slipped off to a splendid start this year with a very well attended Annual Dinner which bordered on the hilarious, throughout. Staff and students alike caught the spirit of the affair, and mirth knew no bounds when our Honorary Chairman, Mr. Eric Haldenby, gave his memorable address on "Classmates of '17".

Speakers, prominent in the profession, and without, have addressed the Club on a variety of subjects. Dean Mitchell very kindly accepted an invitation to come and speak to his architect Engineers, and was good enough to prepare a number of slides for his talk. Mr. Raymond Card gave an amusing and very interesting talk on Stage Architecture, also illustrated with lantern slides. Prof. Arthur described in some detail, with the aid of a set of working drawings, his now famous Packing Plant in Edmonton. Mr. S. J. Chapman spoke to us on the subject of Planning Problems and clarified his suggested solutions in similar fashion. Mr. T. M. West of the Taylor Safe Works very kindly offered to give us enough of his time to explain the ways and means of Record Protection, a problem which had never occurred to most of us before. Our old friend, Miss Phyllis Cook, inspired by her approaching marriage, gave us an extremely interesting account of Modern Architecture which she had studied in Europe during the summer. An open meeting, well attended by brother engineers, was held upon the occasion of Mr. J. M. Packham's showing of the Republic Steel Co. Sound Film on Stainless Steel. Mr. H. S. M. Carver, a noted authority on Town Planning, was kind enough to accept an invitation to address the Club on this subject, and did

so "par excellence". Talks such as these, coupled with organized trips in which the various years have taken part (witness the Brick Luncheon and the Electric Luncheon) have helped to make routine work more interesting, and as time goes on, this phase of Club activity is gradually broadening in scope.

For the last two years, Architectural Club Chairmen have stated in this journal that, "When better parties are held, the Architects will hold them." The third successive TRANSACTIONS may safely repeat this statement. The Mauvais Arts is famous.

To the Staff, for their co-operation and assistance in making most of these things possible, a word of sincere appreciation is here, in order. To the Club members who have helped to make the year a successful one, thanks, and well-wishes for the future, are hereby offered. To "Birmy" Birmingham we give over the Robes of State, confident that the Club will prosper under his leadership.

FREDERICK SMITH, *Chairman.*

FIFTH YEAR ARCHITECTS—1937

Left to Right:

Rear Row: Mr. Carswell, Prof. Arthur, A. G. Keith, Prof. Burden, Prof. Waters, Prof. Madill.

Front Row: W. A. Salter, W. E. Fleury, R. D. Powrie, A. B. Crawford, W. H. Gilleland, F. N. Smith, Ann K. Gauthier, J. T. Ridley, A. M. West, G. L. Seltzer, J. F. C. Smith.

Debates Club

Time marches on. Another year draws rapidly to a close in the history of the S.P.S. Debates Club.

The meetings were a splendid success. The crowds that gathered were "quantitative and qualitative." The first meeting held in Hart House drew an audience of sixty-three members.

The Club was pleased to have as guest speakers: Professor A. R. Zimmer and Mr. M. J. C. Lazier. A hearty interest developed in the resolution that "Canada Should Place More Faith in the Monroe Doctrine than in the British Commonwealth of Nations." H. de V. Partridge, II, and G. Kennedy, I, opened the discussion. A vote taken of the members present showed that S.P.S. was in favour of the British Commonwealth of Nations.

The subject of the payment of athletes playing on intercollegiate teams drew considerable interest and comment. A. E. Johnstone and R. E. Bates opened the discussion with fire. And when the members became heated, the chairman experienced difficulty in maintaining law and order. But the meeting came to a successful conclusion and it was decided that the athletes should not be paid. Incidentally, the Toronto daily papers commended the Club on bringing so vital a subject to the front.

The series of inter-year debates for the Segsworth Trophy were a particular success.

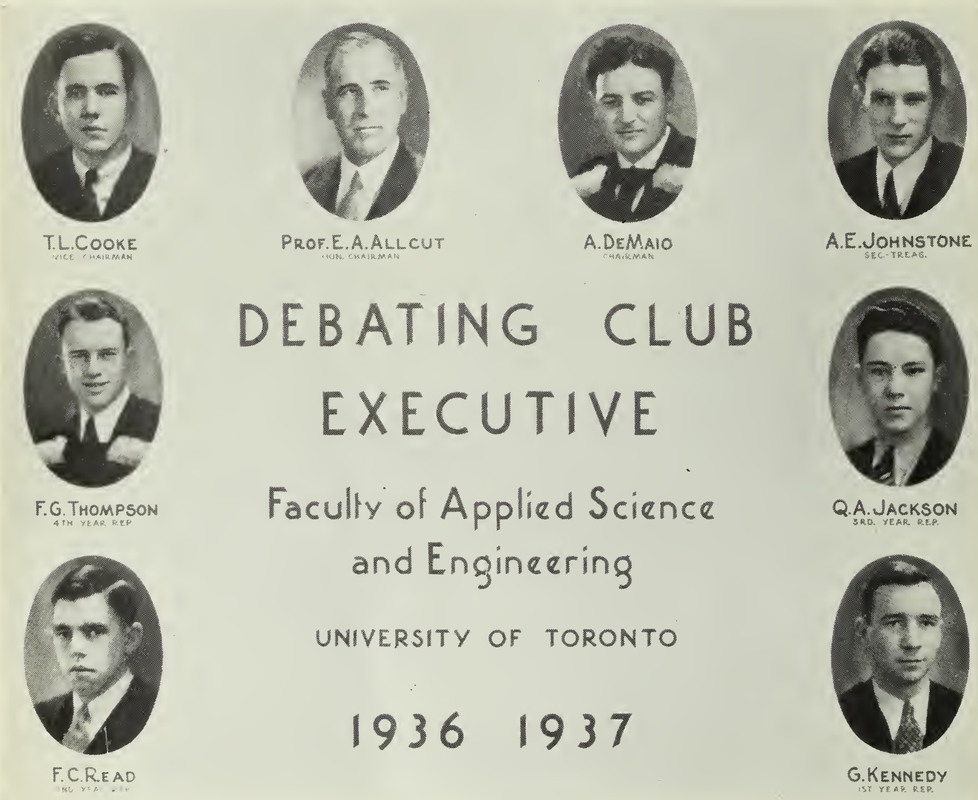
The final debate between III and IV Years, the resolution: "Resolved that Peace is Impossible Under Capitalism," was upheld by Corley Martin and Tom Verity, IV, and opposed by Irvine Smith and Laird Hemphill III.

The executive was fortunate in having Mr. Walter Segsworth, donator of the Trophy, present.

Irvine and Laird took the honours to Third Year, and Mr. Segsworth asked permission to donate a cup to each of the winners, in place of the loving cups which were donated last year.

It is worthy of comment that Mr. Segsworth donated the Trophy to what he claimed was that in which he was the least proficient. The meeting ended with a rousing Toike Oike for Mr. Segsworth.

Consideration is now being given to have the Debates Club executive elected in the same manner as executives of the years, and the Athletic Association. Orchestra Section IX of the Constitution of the Engineering Society is to be replaced by Debates



Club Section IX, if this meets with the approval of the powers that be. This will give the Club a new impetus and its just prominence as a club representing the whole of School.

The executive express their thanks to Doctor R. R. McLaughlin, Professor A. R. Zimmer, Professor A. MacLean and Mr. M. J. C. Lazier, who gladly assisted the Club in the capacity of judges or otherwise, and particularly to Professor E. A. Allcut, who, in the capacity of Honorary Chairman, assisted the executive in making 1936-37 a successful session.

Our best wishes go to Ralph Bates, next year's chairman.

A. DEMAIO,
Chairman.


"The Revue" School Nite - 1937

H.N.POTTER
SEC.-TREAS.

J.V.LEWORTHY
PRESIDENT

W.H.ARISON
VICE-PRESIDENT

F.C.B.HALL
VICE-PRESIDENT

K.O.T.BEARDMORE
COUNCILLOR

PERMANENT EXECUTIVE OF THE CLASS OF 3T7

Faculty of Applied Science and Engineering

UNIVERSITY OF TORONTO

1936 1937

T.M.CHILDERHOSE
COUNCILLOR

C.G.LUMBERS
COUNCILLOR

W.A.SALTER
COUNCILLOR

H.L.TIPPLE
COUNCILLOR

F.G.WALKER
COUNCILLOR

Message of Permanent Executive

Into the archives of the old School has been written another chapter, one that will long be remembered in our Halls, that chapter concerning the varied and colourful doings of the Class of 3T7. Remember the "land-office" business in Sophomore Year Cards, the widely-publicized beard-growing contest, the vari-coloured Toike Oikes, and numerous other landmarks which will definitely locate us in the history of the School.

It has been a memorable four years—working together, playing together, and developing a degree of friendship and co-operation which has come to be known as the "Spirit of 3T7". And now that we are about to make our stir in the outer world as graduates, it is the intention of your permanent executive, with the help of each individual member of the Class, to maintain this friendship and co-operation throughout our future lives. The wheels have been set in motion for the holding together of our class as a live Alumni body for all time to come. At Reunions, School At-Homes, Class meetings, the voice of 3T7 will continue to be heard.

The executive wishes to keep a complete record of the whereabouts, occupation, health and state of each member of the Class. As much of this information as possible will be obtained before the end of the School year. Members who are not settled by then are requested to mail the information to the Secretary-Treasurer, Nev. Potter, as soon as they become permanently located. He has arranged a filing system for keeping this information complete and up-to-date.

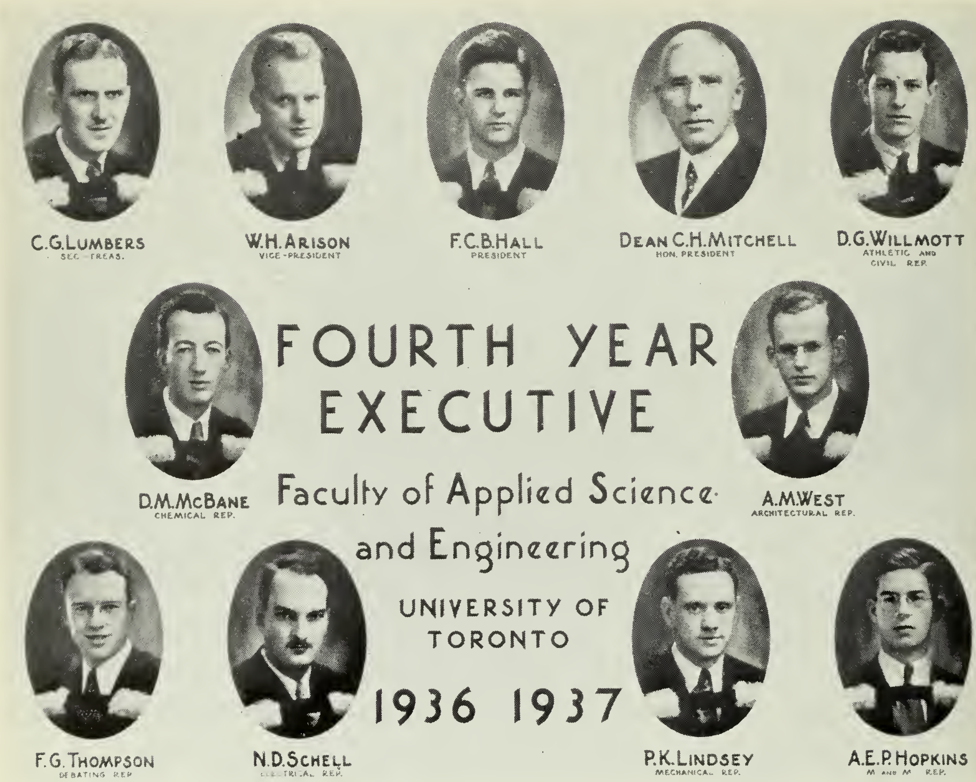
Your permanent executive is anxious to work for you—to keep the class bound together as an influential unit in the future. Write to any one of them about your ideas, about information you require, or just for old time's sake. You will always receive a reply.

We urge you to watch the columns of the University of Toronto Monthly for the news it will contain of our own and of other alumni.

To all members of the class we say "Good luck". May all your energies bring results which will be a credit not only to yourselves, but to the University, our Faculty, and the Class of 3T7.

President
J. V. Leworthy,
54 Harbord St.,
Toronto, Ont.

Secretary-Treasurer
H. N. Potter,
144 Gladstone Ave.,
Toronto, Ont.



Graduation Ball

The undergraduate social activities of the Class of 3T7, S.P.S., ended on March 19th, 1937. It was easily the largest and the most successful function in the history of the class. The ballroom of the Royal York Hotel was arranged in cabaret style and dancing continued throughout the night and into the early morning hours. At midnight supper was served after which a college sing-song and floor show were presented. Novelties were then presented as the dancing continued.

Judging from the frivolity and enthusiasm displayed, all worries about theses, exams, jobs, etc., were "gone with the wind," and the members present proceeded to enjoy the occasion to the utmost.

Here's hoping that 3T7 will continue to have more parties like this when it becomes an active unit of the Alumni!

F. C. B. HALL,
President.

The Class of 3T7

To quote one of the notables of the campus: "The Class of 3T7, S.P.S., has been a very exceptional one, in all its four years at Varsity." This can be said with truth, because 3T7 has been a year of fire, pep, and enthusiasm. In all its undertakings it has met with undreamed-of success.

In the fall of 1933, a crowd of ignorant green-horns came to the Faculty of Applied Science and Engineering and on the first day were baptized, by individual tappings, as the Class of 3T7. At the By-Elections, this pack of green-horns elected very wisely the leadership of Len Sharpe, Nev Potter and Len Foster. From this start developed a unit which, by the end of first year began to show signs of promise—that some day, perhaps a few engineers might be rounded out from its members.

Second year for this class proved sorrowful for incoming Frosh as plans and actions for the Fall Receptions were carried out. This year Nev Potter, Len Foster and Clay Hall took the helm and the good ship made a successful trip with plenty of good parties and the usual class spirit.

In its third year of existence, a dark cloud loomed over the horizon and the boys went to work to keep the ship from sinking. Lab reports—lectures—lab report—lectures, etc. But the scholarly group managed to survive even the ultimate—the final examinations.

This year, the one of graduation, brought the great transformation. The Class seemed to "grow up" over night. With a none-too-certain future ahead, small groups were seen from time to time discussing conditions regarding employment, rather than the usual joke-telling sessions. The Fourth Year is the year when the bulk of the work for a successful year of the Engineering Society lies in its hands. The whole School looked for leadership from the Fourth Year, the same old Class of 3T7, and judging from the results of School Dinner, School Nite, School At-Home, Club activities, and General School Spirit, the School has not been let down or disappointed in any way.

From such a record it is not out of harmony to predict that the members of the Class of 3T7 will certainly make a great contribution to industry, and in years to come, will be the leaders of it.

F. C. B. Hall,
President.

Class of 3T8

Financially, socially and, I hope, academically, this has been a year of success for 3T8.

The desire of all of us, in Third Year, was to have sufficient finances when we reached Fourth Year to be able to have a bang-up Graduation Ball and finish our stay at S.P.S. in a blaze of glory.

The sale of year cards, which is our only source of revenue, was begun immediately school started and was carried on intensively. Only about thirty per cent of the year bought cards, and this meant that if we were to carry the expenses of one dance alone, the funds would be completely used up in a single function.

With this in mind, the executive felt that by sharing the dances with another year they could have better parties at a much smaller cost. Second Year was approached and was very pleased with the idea, the outcome being the Junior-Soph Prom. This was such a social and financial success that the second dance of the year was also held in conjunction with Second Year. This means we of Third Year were able to have two super functions at an average cost of about seventy-three cents a couple.

The final party of the year was a dance for 3T8 alone. It was held just a month before examinations started, with the idea in mind of it being a farewell to social activities until the end of April. So that a reasonable profit could be assured, the executive set out and planned this party with a maximum of ninety cents a couple as the total cost.

It can easily be seen that sharing the expenses of our parties we saved a considerable amount of money and finished the year with a profit of about thirty dollars, or a clean profit of approximately sixty cents on each $3.00 year card sold.

We enter Fourth Year with the hundred dollars left in the bank by Jack Millar at the end of Second Year and an additional thirty dollars from Third Year.

I feel sure that if you all will lend your support to Johnny Langford and his executive by buying year cards, that every social function of your fourth and last year at S.P.S. will be a howling success and the Graduation Ball will be the high-light of your University career.

DUNC ROSS,
President.

Class of 3T9

A resume of Sophomore activities for this year shows that as usual a maximum amount of fun has been squeezed in with the minimum amount of work, making in all an ideal year.

At the beginning of School, the problem of a very large and a very active freshman year presented itself and while the Sophomores did all right, we have to admit that the first year certainly gave almost as much as they took.

The so-called welcome to the freshmen was climaxed in a rather unorthodox manner for S.P.S. by having the freshmen take the Sophomores in a battle for a dunnage bag hung a bit too high on a pole. The battle on Trinity's back campus on October 23rd really showed the spirit of the freshmen and never will the small group of Sophomores present forget that long line of sack-bedecked men which stretched the whole way across the centre campus. It was quite a fight with the write-up in the Varsity the next day making it perfect. At the evening's entertainment following in Hart House, peace was officially declared and bygones became bygones.

The next important event of the year was the Soph-Frosh dance which, as usual, was a real S.P.S. party with everybody there, having a good time plus.

Again departing a little from the usual, a dance was held before Christmas together with the Class of 3T8. The extra number present just made the Boulevard Club bulge comfortably and everybody seemed to enjoy themselves, even patrons and patronesses.

In no time at all the Xmas holidays arrived, providing time to catch up on back sleep and to study for exams. With even greater haste, the holidays came to an end and the grind began once more.

With examinations over and not at all deterred by numerous letters circulated among the boys, everybody settled down to enjoy the round of social events that seem to come around after every Xmas. Conspicuous among these events was another year party held at our old stamping grounds, the Boulevard Club. With a good floor and a good orchestra, the time went all too quickly. S.P.S'ers certainly like their dancing.

It is a pleasure to report that the Year still has money in the bank, the surplus from First Year being intact plus an additional amount, making our financial outlook very fine.

Elections have come and gone, and the retiring executive take

this opportunity of wishing the newly elected officers the best of luck in the exams. With such a skipper and crew, everything should be plain sailing. Hugh Kortright, the president for Third Year of 3T9 will be an able leader and with some interest from you fellows, should be able to make next year a real one.

It's been a lot of fun being sophomores together, so come on men, and keep the gang intact.

PAUL C. ANDERSON,
President.

Class of 4T0

The last beer has been drunk, the last toast raised to First Year, 4T0, for to-morrow we are Sophisticated Sophomores. But ever will linger in our ears. . . . I can teach Calculus to any fool, so why can't you learn it? . . . Did I tell you the story of my baby and the typewriter? . . . Ah. . . . Ah (ten per second). . . . Gentlemen, may I interrupt you for a minute? . . . At this time there is prevalent in the First Year a very base, statistical School of Thought. . . . I notice that all the coming failures are sitting in the back two rows.

After winning the ancient and historical Flag-Rush, with the aid of the Second Year's tomatoes, we tendered a consolation prize to them by staging a right royal battle "The Soph-Frosh." This traditional hop again shed a light of glory on a school renowned for its dances. During the Initiation and Soph-Frosh, we were convinced that not only was the School reeking of spirit, but that in its sacred precincts the light of knowledge burned high and ever higher. We spurned the other Faculties, although we stooped to take their ties, and blessed the kind fate that made us Schoolmen. Let us keep on blessing.

Rugby games, School Dinner, a Year Dance, School Nite, and yet another Year Dance flash by as in a dream. I can hear Loren Cassina beating out a soothing lullaby, Bob Shuttleworth calming our savage breasts with jungle rhythm, Willie Arison crooning "The Way You Look To-Night," and few and far between, a professor's warning voice.

Despite the fact that Mr. Lazier insists that the exam. papers are not thrown out the top floor of the Engineering Building, and that all papers falling on the sidewalk fail, we, doubting, have taken steps to remove the sidewalk.

G. P. DEWAR,
President.


VOTE to
BUSH
Pres
FOR

47th Annual School Dinner

Early in November, several strong men and true were to be seen wandering around School with worried and desperate looks on their faces. Gradually these looks changed to ones of mystery and secrecy. Signs began to sprout in the Little Red Schoolhouse, and finally grew to the titanic dimensions that every Schoolman knows means either a School dinner or war. Those who could not read (including for the most part U.C., Meds, and Wycliffe) were informed of the 47th annual wonder of the world over a public address system that blared its messages of entreaty and pleas for support forth to a chilly campus. The Medical Building and a School Dinner ticket were auctioned off in traditional style, and finally came the great night of November 19th, 1936.

About five hundred loyal Schoolmen gathered fraternally and gastronomically in the Great Hall of Hart House, there to enjoy one of the finest evenings in the memory of your scribe. The traditional turkey, piped in by the Royal School couriers and suitably attired attendants, was well received and polished off in true Blue and Gold style. Ross Workman, who needed no introduction, cleared the men's windpipes with a few choice School songs, led and sung with Engineering gusto. Then the Four Ragamuffins set our feet tapping for a while. Respectful silence followed while the Chancellor of the University, Sir William Mulock, replied to the toast of the Blue and White. To our minds, this was the high spot of the evening, a few brief, witty words delivered in the manner of a man who was one of us. Dean Mitchell advised us to "Look Ahead" in a way which made us all feel that he was not only the Dean of the Faculty, but also one of us, an engineer, urging us on to higher realms of achievement, so that the School in future years might be proud of its graduates. Our applause proved to him our appreciation of his advice.

H. Napier Moore, editor of *MacLean's Magazine*, author of literally hundreds of articles, then rose to address us in the capacity of the speaker of the evening. Mr. Moore's address was one of the most witty and entertaining, yet one of the meatiest and most masterful after-dinner speeches your raconteur has ever heard. He told us of Engineering in the Broader Sense, and developed his theme very broadly to paint a rather threatening picture of war in the near future, only to dispel our qualms by talking "Toike".

And there you are: "Eat, drink, and be merry for to-morrow we work." "The Psalm of Life and Mood Indigo." "It is neither the

traditions nor the buildings which make a university, it is you, its children", said Sir William, and the Dean replied: "Look ahead and climb high." "The Engineering field in the broadest sense opens before you to be conquered, so talk Toike with yourself," said Mr. Moore. We replied with a Toike Oike, and it was all over. Now eager eyes and stomachs are straining toward the 48th Annual School Dinner.

W. H. ARISON.

School Nite

"Toike Oike Reigns at Hart House!" It is startling news, but it was true on the night of January 22nd, 1937. Schoolmen took over Hart House and School celebrated one of the most successful social events in its history.

School Nite was truly "a nite of nights". No less than five orchestras were required to satisfy the dancing moods of eight hundred engineers and their choice of Toronto's fairest. Considering the way an engineering mind runs after business hours, it is not at all surprising that a girl's orchestra was among the more popular features of the evening. For the same reason the engineers packed the swimming gallery twice to see the Dolphinettes put on a colourful and beautiful display of fancy diving and swimming.

Remember the revues of other years? They left a reputation for humorous entertainment that stands high on the campus. With Willie Arison as director and master of ceremonies, this year's revue made up of varied skits easily came up to the mark set for it and was voted a howling success.

The Schoolman, above all, is practical, and so he remembered his stomach sooner or later. A raid was organized on the kitchen, but Hart House was prepared, and the vanguard of the hungry army was met at 10.30 in the Great Hall with tempting sandwiches, cakes and coffee. The assault continued until past midnight, but there was enough for all and both sides retired on the best of terms. The Chemical Club's booth supplying soft drinks and punch was also popular—while the punch lasted.

During the evening, School was honoured by the distinguished patronage of Mrs. H. J. Cody, Mrs. C. H. Mitchell, Mrs. W. J. T. Wright, Mrs. T. R. Loudon, Mrs. V. G. Smith, Mrs. M. C. Boswell, Mrs. W. G. McIntosh.

It was a busy evening even in the two softly lighted sitting-out rooms, and time went much too quickly. It was with feelings of regret in everyone's heart that revelries ceased and it is with the recognition of one of the year's outstanding memories that we now recall School Nite.

K. R. Busby.

G.F. BEARD
TICKET SALES

H.N. POTTER
PRESIDENT

J.V. LEWORTHY
CHAIRMAN

W.A. RAMSAY
PUBLICITY

D.M. McBANE
FINANCE

R.L. CLARK
ACCOMMODATION

SCHOOL NITE COMMITTEE

Faculty of Applied Science and Engineering

UNIVERSITY OF TORONTO

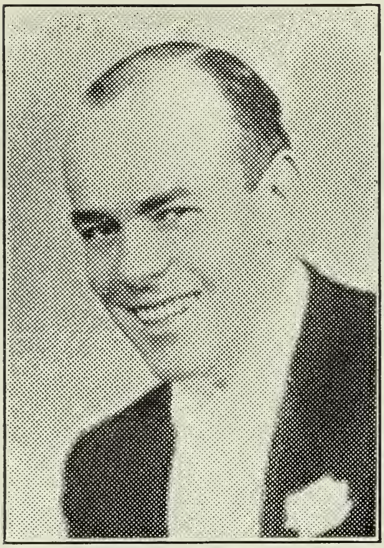
1936 1937

J.R. MILLAR
RECEPTION

W.H. ARISON
"THE REVUE"

B.G. BRONSKILL
MUSIC

School At-Home



On the night of Friday, February 26th, the Engineers' social world reached its climax. True, it has reached some very high peaks in recent times. However, this year, the School At-Home was, to put it simply, the best party of 1937. Even some medical students were heard to admit that it was good.

With an orchestra of the calibre of Jack Denny's the dance was an assured success before it started. But when the dancers reached the floor the music they heard exceeded by far their fondest expectations. The music was marvellous and the novelty numbers were a treat. And! That vivacious little lady, Judy Lane, certainly could sing.

To round out a perfect evening the decorations and the lights were excellent, in the School colours of course. The supper in the Crystal Ballroom at midnight was very tasty and to lend an informal and friendly atmosphere, Jack Denny and Judy Lane sat at the head table.

The patronesses for this great occasion were: Mrs. H. J. Cody, Mrs. C. H. Mitchell, Mrs. C. R. Young, Mrs. J. W. Bain, Mrs. R. W. Angus, Mrs. H. H. Madill, Mrs. G. A. Guess, Mrs. W. J. T. Wright and Mrs. H. W. Price.

A. C. ROGERS
ADVERTISING

J. V. LEWORTHY
CHAIRMAN

H. N. POTTER
PRESIDENT

B. G. BRONSKILL
VICE CHAIRMAN

J. W. KERR
FINANCE

SCHOOL AT-HOME COMMITTEE

Faculty of Applied Science and Engineering

UNIVERSITY OF TORONTO

1936 1937

G. F. BEARD
TICKETS

R. L. CLARK
ACCOMMODATION

C. G. LUMBERS
RECEPTION

W. A. RAMSAY
PRESS

J. R. MILLAR
DELEGATES

Toike Oike

Ollum te chollum te chay!
School of Science, School of Science!
Hurray, hurray, hurray!

You all know that the Toike Oike is the official mouthpiece of the Engineering Society, and is published to celebrate each momentous occasion in the life of an embryo engineer. The Varsity's allegation that the paper only appears at such times when the Editors are sober and out of jail is entirely false and without foundation. The editors lead a strict and God-fearing life? Oh, hear ye, hear ye, forty beers and all that!

Well anyway, it comes out every now and then.

With the innovation of the new set-up on the front page, and the startling color schemes that caught your eye, "every now and then", we believe we have set a precedent, and one which we hope will have a long life. It is our confirmed opinion that these changes have made the Toike Oike more popular than ever.

Each edition has brought you up-to-date news on the current events of School, such as the boisterous Reception, the School Dinner, the riotous School Nite, the colourful At-Home and the bang-up Graduation Ball. Interspersed, a ready flow of humour has been maintained, and we hope, has helped to keep your interest. In addition, the paper has kept you abreast of the School Sports World, in its column Sportoike.

The twelve-page Reunion Edition of Toike Oike that was published in October, set a record, in that it was the largest issue ever to come from press. We express our thanks to the Engineering Alumni Association for their co-operation and help. The School Nite paper in the form of a paper hat also brought favourable comments for its unique design.

We have been honoured by a message from our Dean, C. H. Mitchell, "every now and then". In a bright and witty way, he has given us sound advice which we should all take to heart.

We wish to take this opportunity of wishing future Toike Oike Staffs the best of luck for bigger and better papers.

R.F.SCOTT GREIVE
SPORTOIKE

A.C.ROGERS
EDITOR

W.E.BARNETT
DIRECTOR OF PUBLICATIONS AND PUBLICITY

A.E.G.PENNY
ASSISTANT EDITOR

TOIKE OIKE STAFF

Faculty of Applied Science and Engineering

UNIVERSITY OF TORONTO

1936 1937

A.W.S.BULL
4TH. YEAR REP.

J.M.HALES
3RD. YEAR REP.

Gull Lake Survey Camp

August fifteenth! Thirty budding civil and mining engineers, in one large bunkhouse on the shores of Gull Lake! Why? The 1936 Survey Camp had commenced. The curriculum told us that we were to study the more practical side of surveying and geology. However, rumours from experienced sources had it that such subjects were of minor importance, serving only to help put in time. Research was suggested along certain lines. Does a full moon on the lake have any effect on the deeper emotions? (Co-operation in obtaining the feminine viewpoint was especially desirable). Were there any fish left in Little Bob Lake? What opportunities were there of rousing sleepy Minden, just five miles away, from its year-round lethargy?

We duly admired the bunkhouse with its much bedecked walls and, in groups of three or four, rented canoes with which to explore to its limits this highly renowned place of work and generally settled down for the rest of the summer. You ask us if we did any work. Certainly! We climbed hills galore—the better to enjoy the scenery. We mapped miles of lake shore—to determine whether it was a blonde or a brunette in that cottage across there. We improved highways with the utmost of celerity—that we might have time to visit the Minden tea-room before supper.

We obtained results, too. Fifty couples attended each of the two dances that were "thrown" in the bunkhouse. Of even greater interest were the several parties held around the lake to which many of the campers were invited. In fact, Dunc was missing so much that we moved his bed over to the verandah of the young lady's cottage to save him the trouble of coming back to camp at all.

They say that an army marches on its stomach. So did we; that is, figuratively speaking, and we have Mrs. Minto to thank for our progress. Her meals gave us that purring satisfaction that only advertisers talk about, and we found her eager to co-operate regarding changes in menu at the odd extra snack at the end of a long night around Fortune's wheel or over the cards. Also, it was through her that we were able to obtain lunches to take on week-end canoe trips to points as far as Fenelon Falls.

At this camp we were honoured by a visit from Dr. Bruce Macdonald, Chairman of the Board of Governors, President Cody, and Mr. A. D. LePan, Superintendent of Grounds, who arrived at the camp on Labour Day and remained overnight to have an opportunity of seeing the camp in action. Many of the boys were away

for the week-end but the few remaining heard both Dr. Macdonald and Dr. Cody express their complete satisfaction with the camp.

In the realms of sport, the 1936 campers were no slouches. Our softball team had three fast games against the cottagers around the lake, splitting the honours, with a win and a tie each. Some of the fellows found their greatest pleasure in performing experiments on the stability of a canoe in the rapids. We remember well the night that one party of four, in their "city clothes" (sissies) succeeded in overturning and as a result, the Carnarvon dance hall lacked its usual hilarity. Even the bunkhouse beds joined in the spirt of good fun around the camp and did things that no respectable bed ever does. It was not at all unusual to come back after an enjoyable evening across the lake, to find that a bed had also gone strolling. Finding it an hour or so later upon the hill, or in a punt on the lake, one wondered at the difficult obstacles it had surmounted. It is still a mystery to some, just how Fred Walker's bed managed to climb to the top of the diving tower. The fact remains that it had to be taken down in pieces. There was a piano in the bunkhouse. True, you might not recognize it by either sight or sound but, no doubt, it had once been a fine piano. Fortunately, Clarke Isbister was also at camp, and some of the most enjoyable hours resulted as Clarke made that piano forget its battered legs and off-key notes, and shake out the latest swing music. Ian Jennings also did his bit, as he led us through all the old engineer's songs, and some new ones as well.

As is often the case, there are some things we still wonder about at times. How did "Plummy" manage to live with such a worthless crowd for five weeks? How did Dunc Moore escape being thrown in the lake long before he was? What technique the Civils used in getting so many invitations down the lake? Will "Boulder" Brown's dam ever obtain its rightful place among the world's engineering projects? How did Bill Hogg and Scott Lynn ever manage to study supplementals on such swell nights? Does the Minto cow still remember being chased through the woods at 3 a.m.? Did that Minden tea-room stand the shock of our departure?

You wonder if Survey Camp benefitted by our presence? Without a doubt. After seventeen years its survey stations are at last correctly located and that doggone pegmatite dyke has its boundaries plotted to a fraction of an inch. Did we benefit by camp? Even outside of such details as which end of the transit to look through, the camp was a howling success in our estimation. If the Department of Surveying ever want some enthusiastic boosters for Gull Lake, just let them look for any member of the '36 Camp.

"BUZZ"

S.P.S. Athletic Association

The Athletic Association of the Faculty of Applied Science and Engineering, has up to the present time, been one of the most active Athletic organizations on the campus and "School" has lived up to its reputation this year in every respect.

This session Mr. McCutcheon of the University Athletic Directorate was given complete control of Intramural Sports and S.P.S. joined with the other faculties in showing a decided increase in interest in the activities of this body.

By a new system of scoring in which consideration is made for enrollment and for the number of teams entered from each faculty,

the points are given to the faculties for their participation and success in every Intramural Athletic endeavour. At the end of the year a newly inaugurated Trophy will be presented to the Faculty having the largest total number of points. To the promotion of interest in this new award School again made its contribution, by entering not only two teams in every sport as has been the custom in the past, but by presenting a third team for competition in several of the sports.

In regaining lost championships School was reasonably successful this year by acquiring titles in Lacrosse, Gymnastics and Boxing, Wrestling and Fencing.

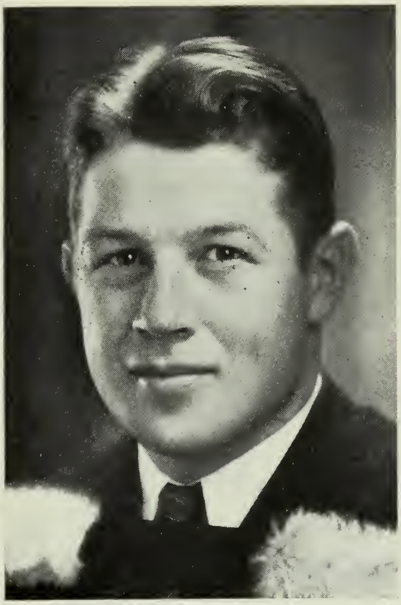
To the incoming executive may we extend our best wishes for success in the 1937-38 session.

Ross L. Clark,
President.

S.P.S. First "T" Holders

As tradition has led us to expect, School still has her quota of first colour men. Rugby has had the continued support of Alison (this year's Bronze "S" holder), Baker, and the more recent services of F. N. Beattie. Jennings has captained the Blue Swimming team through the past season while W. M. Hogg and F. N. Smith have been regular performers on the track and harrier teams. Beard and N. Hogg are probably best known athletically for their respective gymnastic and basketball accomplishments, and MacDonald for his four seasons on the Varsity Rowing Club. At this year's B.W. and F. meet, Bush and Smith represented Varsity in a pugilistic capacity, Lathrop performed for the grapplers and Garcia (a newcomer) carried the fencing honours. B. Houle is a former master of the mat and W. C. Schwenger won the 165 lb. Intercollegiate wrestling.

The Bronze "S"



The most coveted sports award in School has once more been conferred on a worthy Schoolman. The Bronze "S" symbolizes the highest degree of athletic ability and good fellowship, and both these qualities are possessed to an enviable degree by this year's recipient of the honour, Ronald "Butch" Alison.

Ron is known principally throughout the University for his prowess on the rugby field, being one of the most outstanding outside-wings in the Intercollegiate and Interprovincial Leagues during the past few seasons. In his freshman year he played on the Varsity Juniors and the following year stepped up to the Big Blue Team who were crowned Intercollegiate Champions at the end of the season. He again starred with the Senior Team the next year; and the following autumn he held down a regular outside wing position with the powerful Toronto Argonauts.

This fall "Butch" returned to his regular berth with the Varsity Team, and was a standout performer with the fighting Blue Team that again turned all opposition aside to annex the Intercollegiate title. Ron's graduation undoubtedly leaves a big vacancy in the Varsity team. His speed, deadly tackling and wonderful fighting spirit were at all times invaluable assets to whatever team he played for.

As an athlete, he has brought much honour to himself and to School. However, in future years, when athletic achievements and rugby games are but faded memories, Ron's personality, friendliness and sincere likeable character will remain steadfastly fixed in the hearts and thoughts of his fellow men. Whether in lecture room or laboratory his cheerfulness and humour have at all times lightened the task of his classmates.

Therefore, let us all toast this gentleman and athlete. Schoolmen, I give you Ron Alison!

"T" HOLDERS

Second Row: I. Jennings, O. F. Bush, R. A. Baker, F. N. Beattie.
First Row: A. U. Houle, F. N. Smith, W. M. Hogg, N. Hogg, R. G. Alison.
Absent: G. F. Beard, D. G. MacDonald, A. Garcia, D. W. Lathrop, W. C. Schwenger.

"S" HOLDERS

Fifth Row: F. Tuke, R. E. Young, H. B. Ashenhurst, T. Mitchell, R. Ballagh, F. Quance.
Fourth Row: R. C. A. Pittis, F. G. Walker, L. A. Patterson, W. Mark, I. M. Hamer, R. A. Baker.
Third Row: R. Stroud, J. R. Rodzik, N. W. Smith, J. R. Millar, H. J. P. Morgan, O. Bush, J. D. Fox, B. Chernovsky, J. C. Martin.
Second Row: G. Powell, D. McClaren, B. Marks, G. Otter, D. Henry, A. King, F. Beatty, R. Alison, L. Hemphill, M. W. Hollands.
First Row: H. M. Robinson, F. N. Smith, F. C. B. Hall, I. Jennings, N. Hogg, W. M. Hogg, R. A. Rule, S. Murray, R. L. Clark.

Senior School Rugby

This year the Senior Rugby Team shaped up very well in pre-season practice and, under the skilful coaching of Ken McQuarrie, ex-McGill plunging half, gave premise of being an outstanding contender for the Mulock Cup.

The squad was well-balanced with plenty of power along the line, a deadly tackling brigade and a steady backfield. Handicapped, as usual, by the difficulty of getting practices started before dark and by frequent injuries, the team did not win the coveted "Mug", but certainly went down fighting.

In the first game of the year, School definitely outplayed Dents who were very lucky to secure a 6-6 tie. The second game was a nip-and-tuck affair with Sr. Meds, S.P.S. finally managing to eke out a 1-0 victory. St. Mikes provided the next opposition. This game was very well played, but the Saints overcame School's 2 point lead with a placement, the ball dribbling over the cross bar with seconds to go.

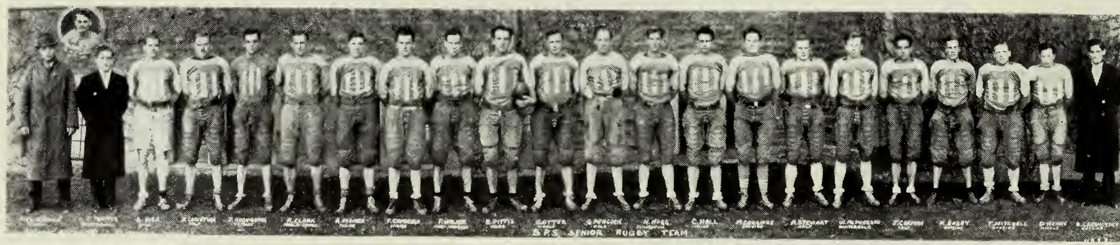
Dents took the return game, largely due to School's shaky playing in the first half. Although now definitely out of the running, the team began to come into its own. In a very well-played and hard-fought game, they spoiled Sr. Meds chances for a play-off position by the score of 2-1. The last battle with St. Mikes was rough, tough, and fast all the way. School led at half time, but one completed forward pass gave St. Mikes the margin of victory.

The final standing of the group showed School in second place and the players were good value all the way.

On behalf of my team-mates and myself I would like to thank Ken McQuarrie very sincerely for his untiring efforts to mould us into a championship team.

It is certainly high time that School regained possession of the Mulock Cup, so to next year's team I wish all the luck on the campus in their attempt to achieve this goal.

F. G. Walker,
Manager.



SENIOR RUGBY TEAM, 1936-37

K. McQuarrie, Coach; J. Troster, quarter-back; G. Dick, snap; J. Christian, half; J. Hornibrook, outside; R. Clark, Captain, middle; A. Fisher, inside; P. Cavanagh, inside; F. Walker, Manager, snap; R. Pittis, inside; G. Otter, middle; G. Peacock, half; N. Hogg, flying wing; C. Hall, inside; M. Carriere, outside; A. Stewart, half; W. McPherson, quarter-back; J. Gorman, half; K. Busby, outside; T. Mitchell, outside; D. Henry, middle; B. Chernovsky, outside.

Junior School Rugby

For the first week the Junior School Rugby Team was a more or less unknown quantity, as it was composed mainly of Frosh about whom little was known. After a short time the team began to take form and appeared to be on the way to big things. However, Lady Luck frowned on the team and they lost their coach due to unforeseen circumstances.

This hard luck did not dampen the team's enthusiasm and they worked harder than ever so that by the time the season was over they had earned the respect of every team they had played against. It is true they won only two of six league games played but it can also be truthfully said that they were more outlucked than outplayed in the games which they lost.

A fact which was pleasing to note this year was that "Schoolmen" were supporting their team much better than in the last few years. If this support continues to improve I'm sure that S.P.S. will recapture the Mulock Trophy.

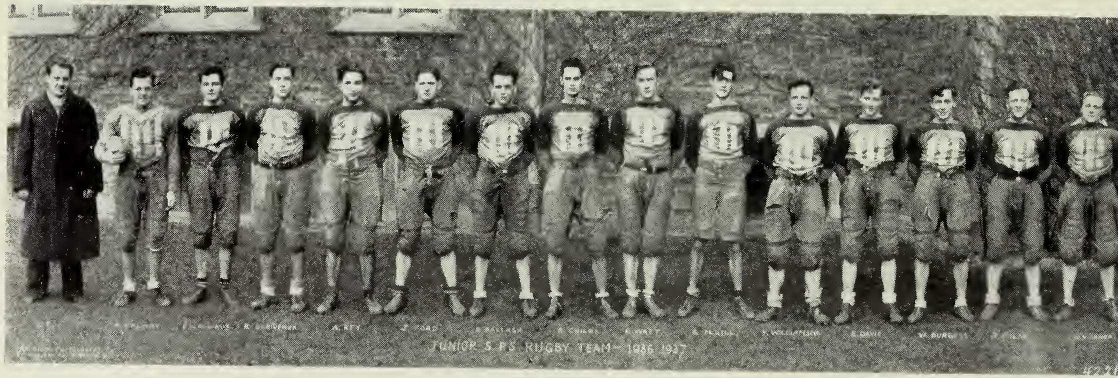
J. D. Fox,
Manager.

School Soccer

The call to arms of the soccer enthusiasts indicated that the team had championship possibilities. The nucleus of the team consisted of members from last year's team and several reinforcements from the team of two years ago. The absence of freshmen at practices this year presents a serious problem for the game in the next few years.

Practices were begun as soon as possible and everyone worked hard with a view to regaining the Arts Faculty Cup. Professor Allcut gave us very valuable ideas with regard to plays and assisted in explaining the difficulties which arose. We suffered a loss however in the departure of Mr. Mat Ward who has coached our soccer teams in collaboration with Professor Allcut for the last few years.

We were grouped with University College and Dentistry and we played home and home games with each. Dentistry did not cause us any concern, and we easily vanquished them by the scores of 4-0 and 3-0. University College, however, had a fine team and we had to be content with a win and a loss both by the score of 1-0.



JUNIOR RUGBY TEAM

J. Fox, Manager; R. Galway, Captain, half; E. Galway, outside wing; R. Scrivener, outside wing; A. Rey, flying wing; J. Ford, middle; B. Ballagh, half; R. Childs, half; E. Watt, middle; G. McGill, half; Y. Williamson, flying wing; R. Davis, middle; W. Burgess, inside; R. Milne, outside; G. Warner, outside.
Absent: G. Woods, snap; N. Gordon, middle.

Having won our group, we entered the playoffs and gained the bye to the finals. Victoria easily defeated Knox and thus earned the right to meet us. The final games were played under extremely adverse conditions and the calibre of play was not as good as it might have been. In the first game, we held the highly tooted Vic team to a 1-1 draw. However, their superoir team work defeated us in the second game 4-1. Congratulations to Victoria. Next year, however, is another year so let us all forge toward the goal and regain the Arts Faculty Cup.

Wm. C. Gordon Fraser,
Manager.

S P.S Boxing, Wrestling and Fencing Team

The B.W. & F. team enjoyed a very successful year and all the athletes who participated in the events enjoyed themselves at the same time. The first chance to show our supriority was in the Junior Interfaculty Assault, held on December ninth, and tenth which had an entry list of well over one hundred and of these thirty-six were from School. The result was a sweeping win for our boys who amassed as many points as all the other faculties put together. There were six boxing weights and eight wrestling weights contested. The champions from School were:

Boxing: N. A. Creet, 135; G. Warner, 145; A. K. Wickson, 165;

Wrestling: J. Troster, 125; E. W. Watt, 165; W. C. Schwenger, 175.

Some of the other boxers and wrestlers such as Barnes, Cooke, Renshaw, Grasley and Cavanagh reached the finals and only lost because they had to fight a Schoolman for the championship.

After the holidays, when the International Intercollegiate meets got under way, our men saw plenty of action as School was well represented on every team. In the wrestling E. W. Watt and R. J. Grasley made the trip to Rochester where Grasley won his bout without much difficulty. Whitey Lathrop fought at the University of Buffalo and at Alfred University and won both bouts, by falls. At St. Lawrence University, Schwenger and Archer did not find the going as easy, but they made a great showing and were wrestling against much heavier men. Schwenger and Lathrop defended the 165 and heavy weights respectively when Varsity played host to the University of Buffalo in Hart House.

In the boxing division, D. Barnes and A. Graham carried

SOCCER TEAM

Second Row: Professor E. A. Allcut, Honorary Coach; A. E. Johnstone; D. Moore; G. Powell; L. Jackson; C. Mudie; E. Wilson.
First Row: B. Woods; J. Jaffe; Wm. C. G. Fraser, Manager and Coach; B. Ashenhurst; F. Tuke.
Absent: M. R. C. Mitchell; K. Shamandurov; I. Thompson; O. Bush.

BOXING, WRESTLING AND FENCING TEAM

Second Row: E. A. Anglin; E. W. Watt; N. A. Creet; G. Renshaw; D. Fensom; A. Garcia; W. C. Schwenger; B. Wilson; D. L. McLaren; G. Warner.
First Row: D. Barnes; D. W. Lathrop; J. Troster; A. U. Houle, Manager; J. R. Rodzik; R. Veales; W. Archer.

Varsity colours at Syracuse and Freddy Smith and Orval Bush, the fight-inclined Architects, did the same when Cornell University brought their hopefuls here. The Senior Interfaculty was a tame affair and S.P.S. won without much difficulty, thus bringing the Davidson Cup to the halls of the little red Schoolhouse for the first time since 1930-31. The boxers were the backbone of the Assault and won every weight. Freddy Smith coasted along to a sure win at 125, while Bush at 135 had tough opposition to overcome and showed himself to be a real champion in doing it. Barnes, a first-year Schoolman, gave him many a hard fight and could easily have taken his place if that had been necessary. D. H. McLaren won the title at 145 while Blake Woods battled his way to the Championship at 155 against Senior Intercollegiate opposition.

Troster at 125 was our only wrestler to win. That is due to the fact that outstanding men such as Lathrop, Scott and Schwenger were kept out of the Assault to give others in their weights a chance.

The big event of the year was the Senior Intercollegiate Assault and four of the boys, namely: Smith, Bush, Schwenger and Lathrop, received their reward for the year's training and battles by being chosen to represent Varsity. The latter three won, giving them Canadian Intercollegiate Championships while Freddy Smith, a former champion, lost on a very unpopular decision.

The Intermediate B.W. & F. team was composed almost entirely of Schoolmen. Those who made places on the team were: Troster, Boyd, Archer, Scott, Barnes and McClaren.

The future of S.P.S. in boxing and wrestling looks very bright indeed. The number of first year men to enter the Junior Assault proves their interest in this form of sport. A serious blow to the team will be the graduation of F. N. Smith, who has been an outstanding boxer and sure point-winner for S.P.S. He placed on the Intercollegiate team every year. It would be too much to hope for a man capable of taking his place.

It has been a great pleasure to associate with the boys who gave their utmost for School in the toughest sport on the Campus. Their achievements were one hundred per cent as they won every championship in each division.

A. U. Houle,
Manager.

School Fencing Team

One of the most promising sections of School athletics, the fencing, deserves particular attention this year for its remarkable progress. The swordsmen have at last reached the high standard of School B.W. and F.

Six men were entered in the Senior Assault, and all gave a good exhibition. As a result, three won places on the Intercollegiate Fencing teams. R. L. Cavanagh, R. T. Wilson and A. Garcia are to be congratulated for their fine work. Both teams won their section of the assaults.

Garcia lost the Interfaculty Championship by only one point, to Mitchell of Trinity, but won first place in the Senior Intercollegiate Assault by a good margin. This is the first time in seven years that Toronto has been completely superior to McGill in fencing.

It is to be hoped that more men of the incoming years can be obtained to carry on this good work. There is plenty of experience, and form to be had in both foil, epee and sabre.

D. S. Fensom.

School Outdoor Track

The School track team this year staged a comeback after the very poor showing of a year ago, but still only placed third in the Interfaculty Meet. The track men made an excellent showing, but the field men failed to gather a single point. Very few of last year's team were back at School, but the freshmen saved the day, and led by Gordon McHenry, made things interesting for some of the more experienced runners. McHenry not only came first in the 100 and 220, in the Interfaculty Meet, but went down to Montreal and showed his heels to the fastest men of the Intercollegiate. Bill Hogg again won the three mile and Bert Ashenhurst placed third in the 100 yds. and second in the 220. School also won the relay with a team of freshmen, namely: Coons, Hitchman, Kingsbury and McHenry. These were the point winners for School, but Piper, Patterson and Hutton all gained a fourth or fifth, and with such an array of first year men, School should have no difficulty in regaining possession of the Rowell Memorial Cup, especially if some good field men turn out next year.

H. B. Ashenhurst,
Manager.

OUTDOOR TRACK TEAM

Second Row: G. A. Piper; R. G. Hitchman; T. G. Quance; J. M. Hacking; E. B. Parsons; G. M. McHenry; B. J. Moriarty.

First Row: T. M. Kingsbury; L. A. Patterson; W. M. Hogg; H. B. Ashenhurst, Manager; J. R. Rodzik; D. F. Hutton.

Absent: G. R. Bruce; H. L. Coons; F. N. Smith; J. C. Langford.

Senior School Basketball

The quints have been spanked!

After starting the season spectacularly by beating Senior Vic. and Vic. III teams by scores 48-18, 47-13 and 48-24, Senior Meds. took their pants down, and likced them to the tune of 18-13 and 15-14.

Even with the "Dribbling Fool", "Rose Petals", dark horse "Honest John", and that bevy of beauties—Mike, Mitch, Berne, Tom, Ronny, Jack and the also ran manager, Senior School was outlooped.

But, however School might have been outscored in the final game with Meds, they were not outplayed at any time during the game.

Coach Hogg, although not willing to give a statement, said it just might have been possible that the team were a bit too over-confident and a little hung-under after the elections.

With the touch luck of losing by one point in the last game, and that in the last minute of play, here is better luck for the Senior hoopers of next year.

C. W. Archibald,
Manager.

Junior School Basketball

In basketball Junior School started the season with quite a splurge, but sad to relate after winning their group, decided they had done enough. Junior U.C., Junior Meds. and Junior Vic. were all defeated in the regular schedule. The first game with Junior U.C. was quite close ending with a score of 19-17. The next was also a close low scoring one, the finla total being 17-12. In this game School showed a nice defense completely shutting out the Vic. boys during the second half. Junior Meds. put up quite a scrap and the 81-27 shows that School finally got around to building up a real score even though the Docs. were right behind. U.C. was beaten for the second time and the group leadership was made a certainty.

After quite a lay-off as far as playing games was concerned the team got under way again in the semi-finals against Senior Meds. Showing their usual spirit, School carried the game right to them, the score being 8-5 at half time for Meds. Even though we had

SENIOR BASKETBALL TEAM

Second Row: G. E. L. Peacock; T. W. Verity; M. R. C. Mitchell; L. N. Harlock.
First Row: J. K. Ronson; B. Chernovsky; C. W. Archibald, Manager; R. F. Mark; J. O. Gorman.
Absent: J. D. Christian.

the lead for a while in the second half their superior height began to tell and we ended on the short side of 32-21.

Our second opponent in the play-offs was St. Mikes A. This game was ding dong all the way and though the score was 12-11 against us a good time was had by all. This loss put us out of the running for another year and we had to let someone else win the championship.

Individually and collectively this year's team was what you call a swell bunch of fellows. We were fortunate in having two complete teams which were the same as to playing ability, making it fine for practices when everybody was there. The cup is not ours, but we had a good time not winning it.

PAUL C. ANDERSON.

School Swimming

School's efforts in Interfaculty swimming this year were marred by the lack of enthusiasm that has been noticeable in this sport for the past several years. Time was when School was the recognized power in this line, and it is hoped that we may soon return to that position, but more participants will have to offer themselves for positions on the teams.

In the Junior Interfaculty, a four-man team composed of Cavell, McLaren, D. Jennings and Tedman competed for School. The latter was the only point-winner, obtaining a second in the 200-yard Breast Stroke.

In the Senior Interfaculty, School did a little better. Otter, Tedman, Laari, Veale, D. Jennings and I. Jennings composed the team, tieing for second place with O.C.E., behind Trinity. The medley relay team, Otter, D. Jennings and I. Jennings, placed second. Veale was third in the 50-yard Free Style. I. Jennings won the 200-yard Breast Stroke Race, taking over three seconds off his own Interfaculty record to set a new one at 2 minutes, 46 seconds. To finish the meet, the Free Style relay team, Laari, D. Jennings, I. Jennings and Veale, came in third.

School was represented on the University Intercollegiate Championship team by George Otter and Ian Jennings, the latter being Captain of the team. Otter swam on the Free Style Relay which came first, and also placed second in the 100-yard Free Style, while Jennings was on the winning Medley Relay Team, and won the 200-yard Breast Stroke Race.

I. JENNINGS,
Manager.

JUNIOR BASKETBALL TEAM

Second Row: F. L. Johnson; W. D. Dawson; W. W. Rapsey; A. B. Ballagh; G. F. Kirby.
First Row: S. Murray; P. C. Anderson, Manager; H. G. Ronson; J. H. Fisher.
Absent: W. McRae.

SENIOR WATERPOLO TEAM

Second Row: J. M. Vanderleck; D. E. G. Schmitt.
First Row: F. V. Pringle; M. W. Hollands; A. B. C. Northover; R. C. A. Pittis, Manager; E. W. G. Giddings; R. S. G. Griffin.
Absent. J. R. Millar.

Senior School Water Polo

It's a long, long drop from Cup-holders to bag-holders, but such was the fate of Senior School. As the fall of 'Frisco in '06, the crash of the Market in '29, so was the plunge of the Senior Water-polo team.

Possessing a team of fair ability, Senior School endeavoured to make up for lack of skill with fighting spirit. This bolstered their defensive strength but they were still unable to take full advantage of scoring chances. Thus they were forced to bow to their better opponents and go winless.

Honourable mention goes to Morey Hollands the chief scorer.

Raymond Griffin who swam miles for School.

Don Schmitt and Garner Giddings, those front line ball-jugglers.

Jack Miller, our Rover and how he roved!

Pringle, who defended the fort valiantly, and was sunk while in action.

Arthur Northover who developed the trick of using the enemies' motive power.

Vanderleck, the long-legged goalie who stopped shot after shot with reckless abandon.

And last but not least? the manager, who handed himself a position on the team and hopped into the game once in a while to cool off. Good luck to a fine group of sportsmen.

Ralph Pittis, *Manager.*

Junior School Water Polo

Junior School started out their water polo schedule with what looked to be a championship team.

The team took their group games without a loss and went confidently into the semi-finals to beat Junior Meds. whom they had already played twice previously.

That game was a surprise to everyone, and Junior Meds. emerged victorious from the first round by a score of 2-1. With total goals to count, Junior School was determined to make up the one goal in the final game but, although they out-played their opponents, the game ended in a tie 1-1 and Junior Meds. won the round by a score of 3-2.

Next year seven of our players graduate to Senior ranks, we hope, and with the added experience we expect to see the Eckhardt Trophy back at School next year.

George E. Otter, *Manager.*

JUNIOR WATERPOLO TEAM

Second Row: R. J. Orok; L. Chambers: F. Walsh; E. Dunlop.
First Row: T. Kingsbury; W. Laari, Captain; G. Otter, Coach; H. de V. Partridge; B. Tedman.
Absent: W. Veal.

SENIOR LACROSSE TEAM

Second Row: C. Martin; P. Lindsey; C. Archibald; J. Gorman; N. Hogg.
First Row: R. Rule, Coach; E. Russell; R. Stroud; G. Walkey.

Senior School Lacrosse

All loyal Schoolmen looked expectantly towards Junior School this year when the lacrosse season opened. Little, if any attention was paid to Senior School, chiefly because the gang was, with one or two exceptions, very inexperienced.

However, we encountered little difficulty winning our group, taking both Pharmacy and St. Mikes each upon two separatee occasions.

By this time, hopes were expressed for an "all School" play-off for the Dafoe Cup. Junior School obtained the bye, and stood aside while Senior School played O.C.E. After winning the first game by two goals, the Seniors were eliminated by losing out in the second by three goals.

The team was composed of Russell in goal who is rapidly improving each year he's out; "Ace" Walkey formed a very tough defence for any opposing home men as well as being our high scorer; Hogg and Gorman were dandy rovers; Stroud and Brough played centre; and Archibald, Graham, Lindsey and Martin all played well on the home.

Hogg, Gorman, and Archibald all played sensationally in their first year out. Our personal opinion is that Nels Hogg is one of the best defensive lacrosse players we have ever seen, and the "Ace" is every bit as good going the other way; the rest of the gang combined with these two to form one of the "fightingest" teams (even the Varsity said so!) ever to respresent School.

Russell A. Rule,
Manager.

Junior S.P.S. Lacrosse Team Interfaculty Champions, 1936

Junior School again annexed the Dafoe Cup emblematic of Interfaculty championship, defeating O.C.E. two games straight, after Senior School had been eliminated in the semi-finals.

Practices started early and with Ballagh, Murray, Rule, Atkinson and Wheaton of the 1934 Dafoe Cup Team back at School the prospects looked very bright indeed. Then with such freshmen as J. Murray, Wood (goal), Brown and Douglas, and in addition Robinson and Kirby of last year's team rounded out a formidable line up.

This year, Junior School were grouped with University College,

JUNIOR LACROSSE TEAM

R. E. Bates, Manager; G. F. Kirby; H. M. Robinson; S. Murray; A. B. Ballagh; F. G. Brown; J. Murray; A. D. Douglass; R. A. Rule; W. C. Atkinson; I. G. Wheaton; L. Wood.

Victoria and Meds, and romped home in the regular schedule with only one defeat.

With both Senior and Junior School winning their respective groups it looked promising for an All-School Final, but after a hectic battle in the semi-finals with O.C.E., Senior S.P.S. were eliminated. However, the Junior Team really went to work on the teachers and won the two games in the finals 13-11, 17-8.

To pick individual stars would be difficult and unfair since all of the men turned in creditable performances during the season. Suffice it to say that School has an excellent chance of having another cup team next year.

R. A. Bates,
Manager.

Senior School Baseball

This year Senior School had one of the best teams in many years, consisting of half of last year's team. Hopes were running high that the Spalding Cup would be brought to the School.

The grouping was the same as in previous years, with Dents, Pharmacy and School.

In the first game, the team defeated Pharmacy by 5-3. Marks, pitching, and Busby, catching, stood out in the win. The fielding was good and the batting left little to be desired. The team then pulled a loss into a tie with Dents in the last inning. The score was 3-3. The second game with Pharmacy ended in an 8-5 win. The hitting was free and the fielding was good.

In the last game with Dents they lost 9-7. Dents have a strong team and School was not quite able to overcome the eight runs they "spotted" them in the first inning. This meant the end as Dents took two games from Pharmacy.

The team was an all-star team and it is unfortunate that they didn't get past the first group. The team had Busby as catcher, Marks and McMillin as pitchers, Peacock, Willmot, and Macdougall on the bases, and King, Jaffe, Chernovsky and Deluca in the field. As substitutes Troster and Freestone filled in. It was a good-fielding, hard-hitting team which never stopped fighting till the last man was out.

Not being able themselves to bring the championship to School, they wish next year's team the best of luck and hope for a championship for next year.

F. R. Quance,
Manager.

SENIOR BASEBALL TEAM

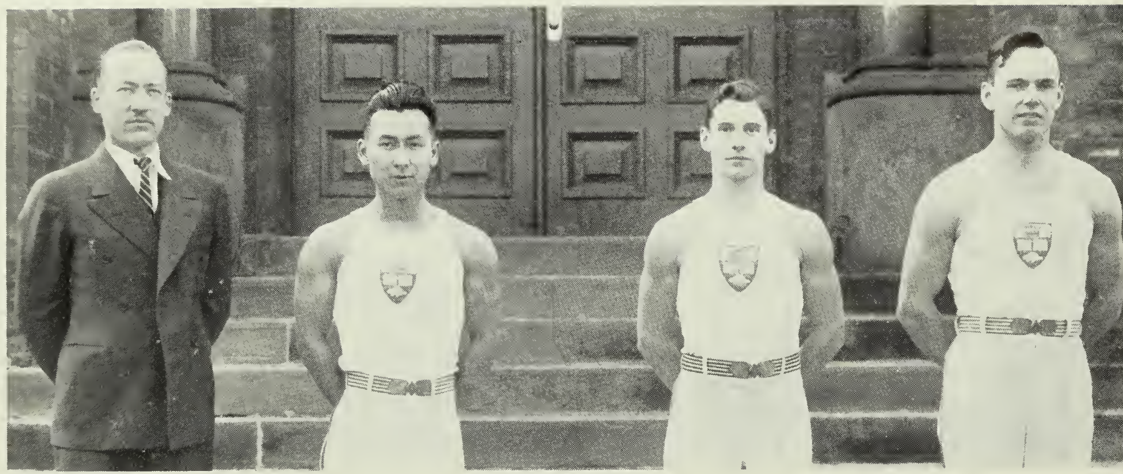
Second Row: L. G. MACDOUGALL; K. R. BUSBY; G. E. L. PEACOCK; H. A. FREESTONE; E. DELUCA; J. B. JAFFE.
First Row. J. M. TROSTER; B. MARKS; F. R. QUANCE, Manager; J. P. MCMILLIN, Captain; B. CHERNOVSKY; A. E. KING; D. G. WILLMOT.

SENIOR HOCKEY TEAM

Second Row: K. MacQuarrie, Coach; A. Fisher; G. Walkey; A. King; E. Russell, Manager.
First Row: J. Leslie; B. Woods; G. Giddings; L. Hemphill; D. Willmot; I. Hamer; N. Smith.
Absent: M. O'Leary.

JUNIOR BASEBALL TEAM

Second Row. W. DIAK; F. R. GERRY; R. THOMPSON; J. FISHER; N. D. LINDSAY; J. M. GIBSON, Manager.
First Row. G. KENNEDY; J. J. BROWN; M. ROBINSON; F. L. JOHNSON; E. C. BRISCO.
Absent: B. MORIARTY; G. WHEATON.



GYMNASTIC TEAM

H. F. Bencry, Manager; W. Mark; W. J. Lester; W. H. Powell.

Junior School Baseball

With only two of last year's team out, this year's Junior School Baseball club had to be built from the ground up. During the first few practices, Diak, a pitcher of championship calibre, was unearthed, and a team of smart fielders and powerful hitters was built behind him.

Our first two games were played against Junior U.C., and were easy wins for the smart-fielding, hard-hitting Juniors to the tune of 13-2 and 11-0. In the latter game Diak twirled a no-run, no-hit master piece and the team was full value for its win.

Against Meds. however, lack of experience and a tendency to blow up in the pinches proved too much for us and we dropped two straight to the Doctors, 4-1 and 8-1.

Thus, considering everything, the season was quite successful, and with the team composed of quite a few first year men, next year's team will in all probability, really go places.

J. M. Gibson,
Manager.

School Gym Team

This year's crop of gymnasts from the Little Red Schoolhouse has been very good. There were very few injuries during the year, and what there were occurred immediately preceding the Inter-faculty Meet, when the big push was on. They included Powell, with a wrenched shoulder, Patterson, with a slight concussion and Phillips, with a dislocated wrist.

In spite of these handicaps, we Engineers captured first and third places for the two teams entered. This netted us the H. A. Wilson Trophy. We had three out of five representatives on the Intercollegiate Championship team. The Intercollegiate meet was held in Toronto this year, and from our standpoint was a great success.

H. F. Bengry,
Manager.

JUNIOR HOCKEY TEAM

Second Row: G. Woods; R. Galway; J. Ford, Manager; W. Disher; R. Cavanagh; D. Crichton.
First Row: J. Lindsay; W. Pringle; J. Smith; J. Smart; A. Rey.

Junior School Hockey

Represented by a well-balanced team with more than average hockey ability, Junior School, after six hard fought games, gained a position in the play offs for the Jennings Cup.

The Engineers started off poorly losing to Senior U.C. by 2-1, but after that we had better luck winning from Junior Meds 2-0 and Trinity 3-1. Then we had two games with Dents and Vic, but both resulted in ties, 1-1 and 2-2 respectively. Next came Senior School who went down to the tune of 6-2.

Lindsey, Disher and Woods made up one strong line while Galway, Rey and Crichton made up the other. Both lines proved very fast and ever-dangerous. Pringle, Smart and Cavanagh stood up well on defence. Smith in goal also proved good.

But alas! we met our doom at the start of the play-offs when we met Vic's strong team in two games, goals to count. The final game caught us on an off day and Vic won 4-0. The next game, although we outplayed them again we were unable to score while Vic netted two more to advance to the next round.

Though not winning the championship, Schoolmen had a great year and maintained their prestige as being one of the most feared and spirited teams on the campus.

J. FORD,
Manager.

The Rifle Association

Once again, for the sixth consecutive year, S.P.S. has won the Mitchell Cup, emblematic of interfaculty supremacy in rifle shooting. The cup was won with a score of 975 out of a possible 1000; Meds. were in second place with a score of 944, and Arts were third with 940. The competition consisted of three matches, one in December, one in January and one in February. The men having the best two scores in the three matches represented the Faculty. The individual scores of the School team were: J. E. Lee, 199; D. C. Anderson, 196; A. S. Foreman, 194; C. Miall, 194; J. I. Thompson, 192.

In the individual aggregate competition Schoolmen again showed their shooting ability. This competition is decided on the total scores of several matches fired throughout the year. The scores were: 1st, J. E. Lee, 348; 2nd, A. S. Foreman, 343; 3rd, D. C. Anderson, 343; 4th, C. Miall, 339; 5th, J. I. Thompson, 337; all are from S.P.S. of course.

The team representing the University in the Toronto Indoor Rifle League ended up in third place this year. The North Toronto Rifle Club won first palce. As the majority of the members who won the Robbins Trophy for the University last year had graduated this position was not surprising. On this six-man team were five Schoolmen already mentioned.

While the membership of the Rifle Association was slightly smaller than last year, the members did enough shooting to necessitate opening the range four days a week instead of three. There were 30,000 rounds of ammunition fired in the Hart House range during the season.

Next fall there will again be outdoor shooting with the service rifle at Long Branch. This will be good news to those who were disappointed last fall.

Schoolmen, this is a worthy sport, come and join next year. If you can shoot we need you; if you cannot we will teach you.

J. E. Lee,
Manager.

Canadian Officers Training Corps

"C" Company of the University of Toronto contingent of the C.O.T.C. is the "School" Company; and is as always larger in numbers than the Companies recruited from the other Faculties.

This may be partly due to the interesting character of the special instruction which is available only to "School" men, such as Military Engineering, Surveying, Mapping, Signalling, Radio, etc.; that this training is accepted by the University in lieu of the Physical Training which is compulsory during the first two years of attendance; and possibly to the fact that "School" men desire to be well informed on both sides of such subjects as National defense, protection of essential trade routes, and the possibilities of maintaining international peace. Opportunities are presented to the members of the Corps to obtain certificates of qualification as Lieutenants and Captains in the Canadian Militia and other Empire Forces. There is no fee charged for these special courses, and militia pay is drawn by all members of the unit who are efficient.

Most of the officers, and all the non-commissioned officers of the contingent are appointed from among undergraduate members; and although the contingent is a unit of the Action Militia of Canada, members, other than officers, are no more liable to be called into active service than any other citizen of Canada.

During the past year the following "School" undergraduates received Commissions as Officers in the Corps:

J. T. Hodgson, III Year Electrical
C. Bridges, III Year Chemical
H. E. deLagran, III Year Electrical
G. T. Maher, II Year Mechanical

Also nineteen other members of "C" Company obtained certificates of qualification as officers.

Numerous former members of the Contingent have adopted Military work as a profession after graduation, obtaining Commissions in the Permanent Canadian Militia and Air Force, various arms of the British Army, Air Force and the Indian Army.

It is worthy of note that the training offered in the Corps is the only method of obtaining officer's qualifications without first obtaining a provisional commission in a military unit, or graduating from the Royal Military College.

In addition to the special training mentioned above open only to "School" men, instruction is available in economic geography,

including international and colonial relations, trade routes, general strategy, etc., also in organization and superintending bodies of men, the rapid appreciation of situations, and the economic prosecution of projects, as well as the formal infantry and artillery work.

A special ground course in Aeronautics will also be available to members of the Corps next training season.

Special prizes are awarded for shooting on the Hart House rifle range. While "C" Company reached only third place this year, it has topped the list nearly every year. C. S. M. MacEwen and Sgt. Elms, however, won the Company honours this year and received prizes of $8.00 and $5.00 respectively.

The annual Ball of the contingent, held in Hart House, has always been one of the most brilliant of the University social functions.

Members of the C.O.T.C. band, who also constitute the U. of T. band, receive free training in band music. They also attend all senior rugby games free, and provide an outstanding event in musical circles at their annual concert in Convocation Hall.

The present strength of the Contingent is 287, all ranks, of which "C" Company provides 106 members.

Information may be obtained at 184 College Street (just west of the Mining Building), where the Contingent's library, reading and lecture rooms are located, or from any officer of the Corps.

THE UNIVERSITY OF TORONTO ENGINEERING SOCIETY

BALANCE SHEET

AS AT 31st MARCH 1937

ASSETS

1936			
	CURRENT ASSETS		
$ 47.56	Cash on Hand	$ 335.23	
2,528.02	Bank Balance—Savings Account	1,540.84	
	Bank Balance—Current Account	191.71	
619.37	Accounts Receivable	525.98	
1.00	Suspense—Returned Cheques	1.00	
2,231.51	Merchandise Inventory	2,205.52	
			$ 4,800.28
$ 5,427.46			
	INVESTMENTS		
	Dominion Government and Government		
4,000.00	Guaranteed Bonds at Par	4,000.00	
41.17	Add Accrued Interest	41.17	
			4,041.17
$ 4,041.17			
	FIXED ASSETS		
1,327.39	Office Equipment	1,342.39	
961.17	Less Reserve for Depreciation	1,037.72	
			304.67
$ 366.22			
	DEFERRED EXPENSE		
13.33	Unexpired Insurance		
$ 9,848.18			$ 9,146.12

LIABILITIES AND SURPLUS

	CURRENT LIABILITIES	
$ 1,654.78	Accounts Payable	$ 1.195.95
177.07	Bank Overdraft—Current Account	
1,831.85		
8,016.33	Surplus Account	7,950.17
$ 9,848.18		$ 9,146.12

OPERATING STATEMENT

1st APRIL 1936 TO 31st MARCH 1937

$11,479.34	Sales		$11,739.71
2,447.59	Inventory 1st April 1936	$ 2,231.51	
8,237.13	Purchases	9,042.26	
10,684.72		11,273.77	
2,231.51	Less Inventory 31st March 1937	2,205.52	
8,453.21	Cost of Goods Sold		9,068.25
3,026.13	Gross Trading Profit		2,671.46
1,639.10	Salaries		1,496.25
$ 1,387.03			$ 1,175.21

THE UNIVERSITY OF TORONTO ENGINEERING SOCIETY

STATEMENT OF INCOME AND EXPENDITURE

1st APRIL 1936 TO 31st MARCH 1937

	Income		
$ 1,387.03	Net Operating Profit from Supply Department	$ 1,175.21	
1,528.00	Fees	1,568.00	
215.97	Interest and Discount	198.98	
			$ 2,942.19
254.98	Excess of Expenditure over Income to Surplus Account		42.44
$ 3,385.98			$ 2,984.63

	Operating Expenses			
	General Expense:			
	Telephone	$68.03		
	Delegates' Expenses	59.19		
	Delegates' Entertainment	70.00		
	Guests' Entertainment	77.92		
	Sundry Expenses	46.08		
$ 293.08			$ 321.22	
82.50	Grants to Affiliated Clubs		25.00	
111.71	Scholarships and Certificates		101.25	
165.09	Donations		196.80	
240.89	Dinner—Deficit		268.70	
112.47	Election Expense		134.47	
169.86	School Nite		106.02	
282.50	Photographs		315.00	
1,270.06	Publications		864.99	
96.31	Depreciation-Office Equipment		76.55	
18.33	Insurance		18.33	
58.20	Printing and Stationery		51.30	
438.96	Convention Expenses			
46.02	School At-Home		505.00	
				2,984.63
$ 3,385.98				
				$ 2,984.63

SURPLUS ACCOUNT

1st APRIL 1936 TO 31st MARCH 1937

$ 8,271.31	Balance 1st April 1936		$ 8,016.33
254.98	Excess of Expenditure over Income for year ended 31st March 1937	$ 42.44	
	Sundry Expenditures applicable to year ended 31st March 1936-net	23.72	
8,016.33	Balance to Balance Sheet	7,950.17	
$ 8,271.31		$ 8,016.33	$ 8,016.33